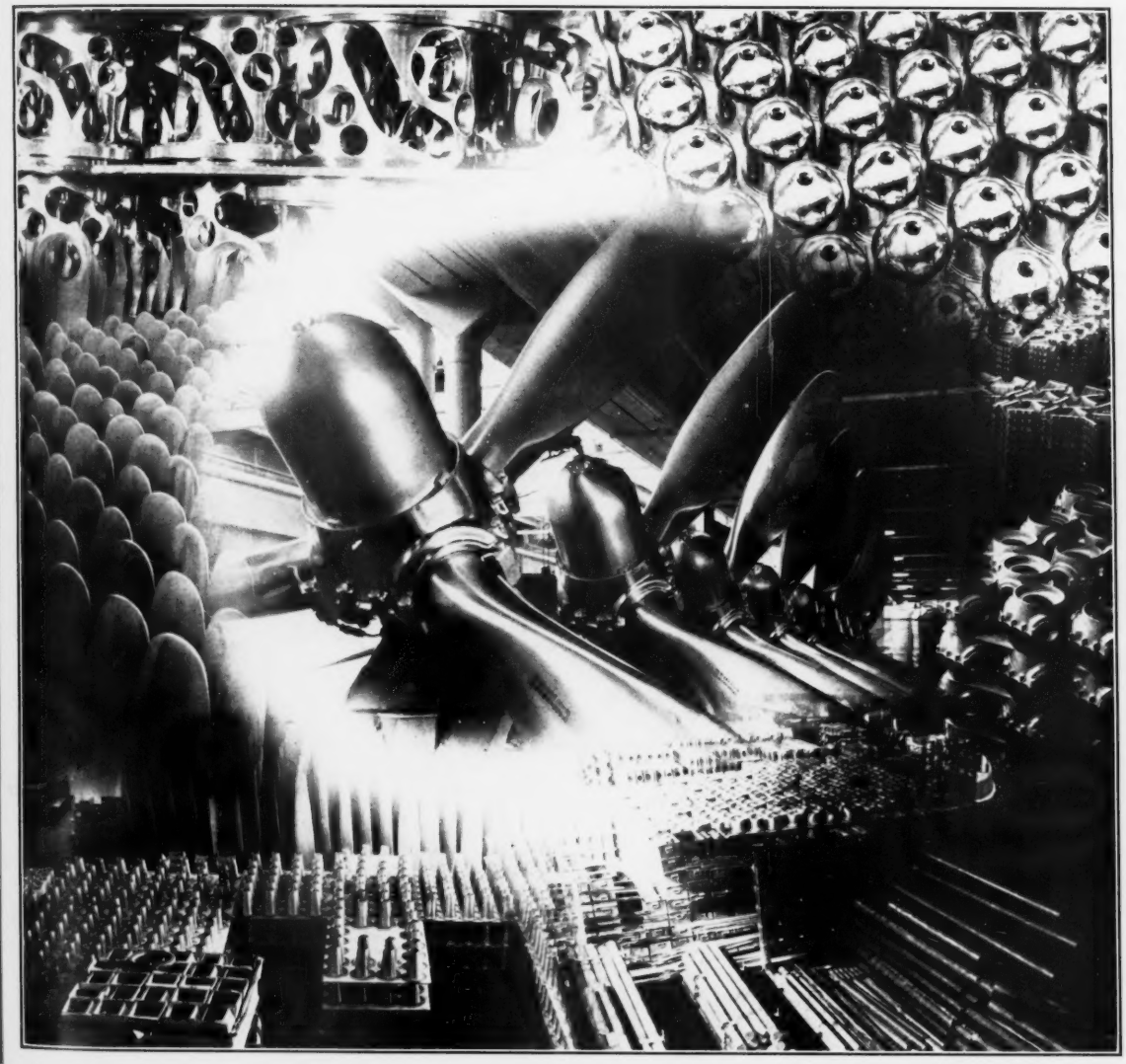
AST

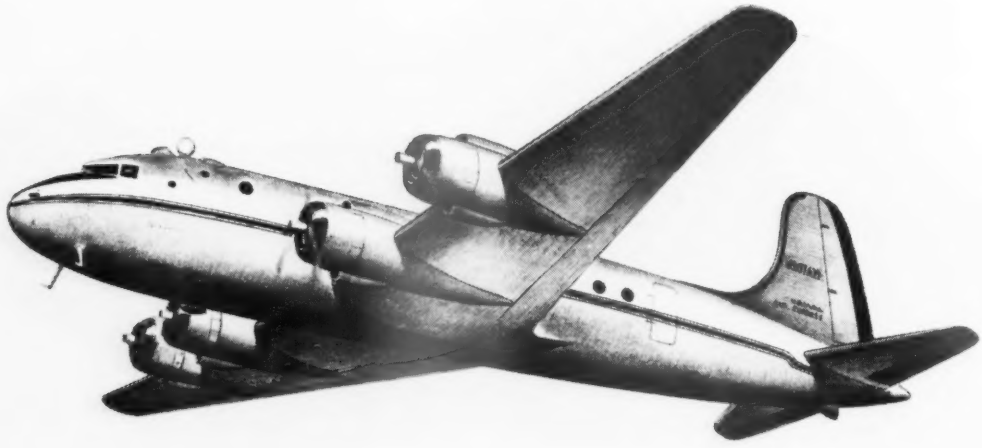
AERONAUTICAL ENGINEERING REVIEW

PRINCETON PH ARE
RECEIVED APR 6 1946

MARCH 1946



Here's why most Airlines specify Champion Spark Plugs



THEY'RE DEPENDABLE!

C26—
Unshielded

RC35S—
Shielded Type

Your choice of Champion Spark Plugs is made easy and sure if you follow the judgment and experience of men who know spark plugs best. Most airlines find in Champions indispensable qualities of maximum performance and dependability. Champion Spark Plug Company, Toledo 1, Ohio.

INSTALL CHAMPIONS AND FLY WITH CONFIDENCE

AERONAUTICAL ENGINEERING REVIEW

Published Monthly by the Institute of the Aeronautical Sciences, Inc., as a Part of the Services of the Aeronautical Archives

March, 1946

Vol. 5 **No. 3**

Copyright, 1946, by the Institute of the Aeronautical Sciences, Inc.

OFFICERS

President
Arthur E. Raymond

Vice-Presidents
P. R. Bassett
John C. Leslie
J. H. Kindelberger
Burdette S. Wright

Executive Vice-President
Bennett H. Horchler

Treasurer
C. S. Jones

Assistant to the President
George R. Forman

Secretary
Robert R. Dexter

Controller
Joseph J. Maitan

Council
Lester D. Gardner, *Chairman*
E. E. Aldrin
Peter Altman
Rex B. Beisel
Lawrence D. Bell
George W. Brady
W. A. M. Burden
Charles H. Colvin
James H. Doolittle
William K. Ebel
Sherman M. Fairchild
Donald W. Finlay
Charles Froesch
Leroy R. Grumman
R. Paul Harrington
W. Wallace Kellett
Otto E. Kirchner
Jerome Lederer
Robert J. Minshall
Earl D. Osborn
Elmer A. Sperry, Jr.
Ernest G. Stout
Fred E. Weick

Pacific Coast Executive
William H. Dudley
6715 Hollywood Blvd., Hollywood 28, Calif.

SUBSCRIPTION RATES

Aeronautical Engineering Review: United States and possessions, 1 year, $3.00; single copies $0.30. Foreign countries including Canada (American Currency Rates), 1 year, $3.50; single copies, $0.35.

Journal of the Aeronautical Sciences: United States and possessions, 1 year, $7.00; single copies, $2.00. Foreign countries including Canada (American Currency Rates), 1 year, $9.00; single copies, $2.50.

Entered as second-class matter at the Post Office, Easton, Pa., April 29, 1942. Acceptance for mailing at a Special Rate of Postage as provided for in the Act of August 24, 1912.

Publication Office: 20th & Northampton Streets, Easton, Pa.

Editorial Office: 2 East 64th Street, New York 21, N. Y.

Notices of change of address should be sent to the Institute at least 30 days prior to actual change of address.

Statements and opinions expressed in the Aeronautical Engineering Review are to be understood as individual expressions and not those of the Institute.

CONTENTS

Cover Illustration

Components entering into the production of Hamilton Standard hydromatic propellers

Articles

Flying Boats . . . . . **C. H. Schildhauer** 5
Itinerant Aircraft Radio . . . . . **H. T. Sagert** 10
Control Operation of a Spratt Wing . **George G. Spratt** 16

Reviews

Periodicals 77
Government Publications 111
Books 115
The Civil Air War
Why Has America No Rigid Airships?
Production Illustration
House Organs and Catalogues 117
From the Industry 123

General

Institute News 51
Personnel Opportunities 63
I.A.S. Honors Night Victory Dinner 21
I.A.S. Fourteenth Annual Meeting 39
Appreciation to Corporate Members 38
Index to Advertisers 137

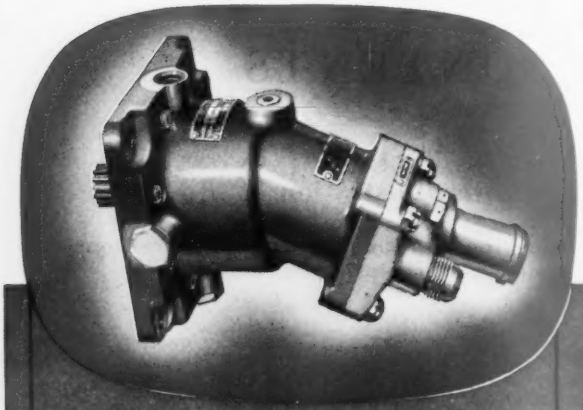
George R. Forman, ***Editor*** **Russell F. Rogers** ***Manager***

Harris F. Reeve, ***Managing Editor***

Associate Editors: **Gail Wadro, Berneice H. Jarck, Edward G. Ingram**

after 1659 hours ON A DOUGLAS C-54

the Performance of this 3000 psi VICKERS PUMP is "AS GOOD AS NEW"



	PERFORMANCE REQUIREMENTS of Series PF-3911 Pumps at Factory	ACTUAL TEST PERFORMANCE of a PF-3911 Pump After 1659 Hours Flight Time On C-54
VOLUMETRIC EFFICIENCY AT 3000 psi AND 3600 rpm	95.0%	97.2%
OVERALL MECHANICAL EFFICIENCY AT 3000 psi AND 3600 rpm	88.0%	91.9%

Factory tests of this pump after completing 1659 flying hours on a Douglas C-54 proved that it would still pass inspection for a new pump—that it was still "as good as new." Test data reproduced above indicate that it is substantially better than the high minimum performance requirements for a new Vickers pump both in volumetric efficiency and in overall mechanical efficiency. Careful inspection after disassembly revealed that this pump required no replacement of parts. A synthetic rubber seal was replaced and the pump was then reassembled and returned to service.

This record of continuous service was made without overhaul; the pump kept right on supplying oil at 3000 psi without any difficulty at all. When finally removed, it was for inspection only.

As a matter of fact, all Vickers Hydraulic Equipment for aircraft is designed for maximum utilization. In addition to constant delivery piston type pumps, there are variable delivery pumps, accumulators, relief valves, unloading valves, power brake valves, motors, sequence controls, pressure reducing valves, etc.

Vickers Hydraulic Aircraft Equipment served the Air Forces well on combat planes. It is now helping to increase utilization in peacetime aviation.

VICKERS Incorporated • 1414 OAKMAN BLVD., DETROIT, MICH.

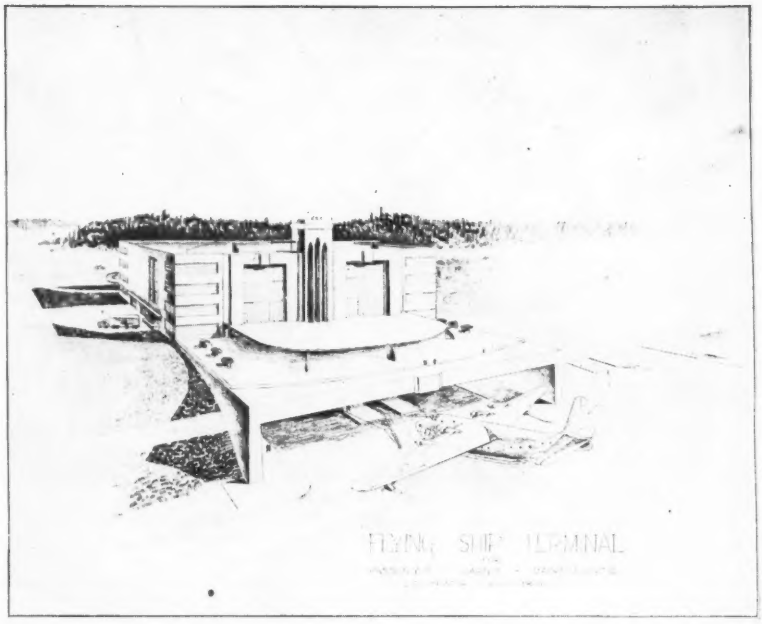
Engineers and Builders of OIL HYDRAULIC EQUIPMENT

SINCE 1921

FLYING BOATS*

C. H. SCHILDHAUER†

Naval Air Transport Service Command



Introduction

The controversy raging around the flying boat today is like the storm of criticism that battered the battleship in 1920. Some people are saying that the flying boat has outlived its usefulness not only as a military aircraft but as a commercial carrier as well. And back in 1920 there were people who loudly proclaimed that the dreadnaught was all through. Look at the record 25 years later. During the war just finished the battleship proved that it was anything but finished. Our well-balanced and mighty Navy featured both battleships and aircraft, working together smoothly as a team. In that connection, it is interesting to note that back in the twenties the carrier with its aircraft was thought of as a unit to protect the so-called vulnerable battleship. In the war against Germany and Japan, the tables were turned. The development of armor and rapid fire antiaircraft guns, like the Oerlikon and others, saw the battleship assuming new stature. It became the protector of the carrier. And so it has been throughout the history of arms. New weapons quickly give rise to counterweapons, and new developments skyrocket old devices from the brink of obsolescence to a place in the sun.

That philosophical thought brings us to a consideration of the use of atomic energy in the atomic bomb. Atomic energy has long been known, but today the atomic bomb is definitely an unknown quantity insofar as its ultimate effect on the present-day weapons of war is concerned. We know of its terrible destructive force. This knowledge lends weight to the assumption that the future use of the atomic bomb may be more strategic than tactical. That means that high-altitude aircraft will be required to carry it over great distances. In most cases the goal will not be pin-point objectives but great military centers. Contrary to the thinking in some quarters, the advent of the atomic bomb will not eliminate the Army and the Navy. The atomic bomb must be carried to its objective, and only the armed forces can do that. Yes, we will continue to have a Navy and the battleship, the carrier and the flying boat will be part of it.

The Flying Boat as a War Weapon

Let us consider for a moment the misconception, popular in some quarters, that the flying boat is an outmoded weapon of war. The two biggest navies in the world, our own and Britain's, certainly do not share that opinion. Their use of the boat in the conflict just concluded proves that. The U.S. Navy used Consolidated Coronados and Martin Mariners to spearhead the entire advance across the Pacific. These same aircraft were used effectively in the Atlantic on antisubmarine patrols. And the British in protecting their convoy routes in the North and South Atlantic used Short Sunderland flying boats almost exclusively for an aerial umbrella. Only recently, Admiral Mitscher paid tribute to the flying boat when he declared: "Carrier supremacy aided by the Navy's long-range seaplanes and land-based search planes now represent a mobile force which will be Naval Aviation's contribution to keeping the peace which it has helped to win." That statement coming from one of the foremost strategists in naval aviation today would seem to indicate that the flying boat has a definite place in the Navy of tomorrow.

Capt. C. H. Childhauer.

The versatility of the flying boat is perhaps one of its greatest features. Its flying fields are the waters of the seven seas. This point was remarkably illustrated by Fleet Adm. Chester W. Nimitz when he went to Tokyo for the signing of the peace treaty. Admiral Nimitz and his staff used two Coronados for their journey to Nippon and they landed right in Tokyo Harbor—just one of the numerous water landing areas adjacent to the heart of Japan's centers of population. This, you will agree, accentuates the ability of the flying ship to operate without prepared landing fields. A country at war must stand ready to support its military operations far afield. Often, the success of a venture may depend on adequate aerial support. Occasionally, such support is needed in a hurry. It cannot wait until flying fields are made available. That is where the flying boat comes into its own, as it frequently did during World War II.

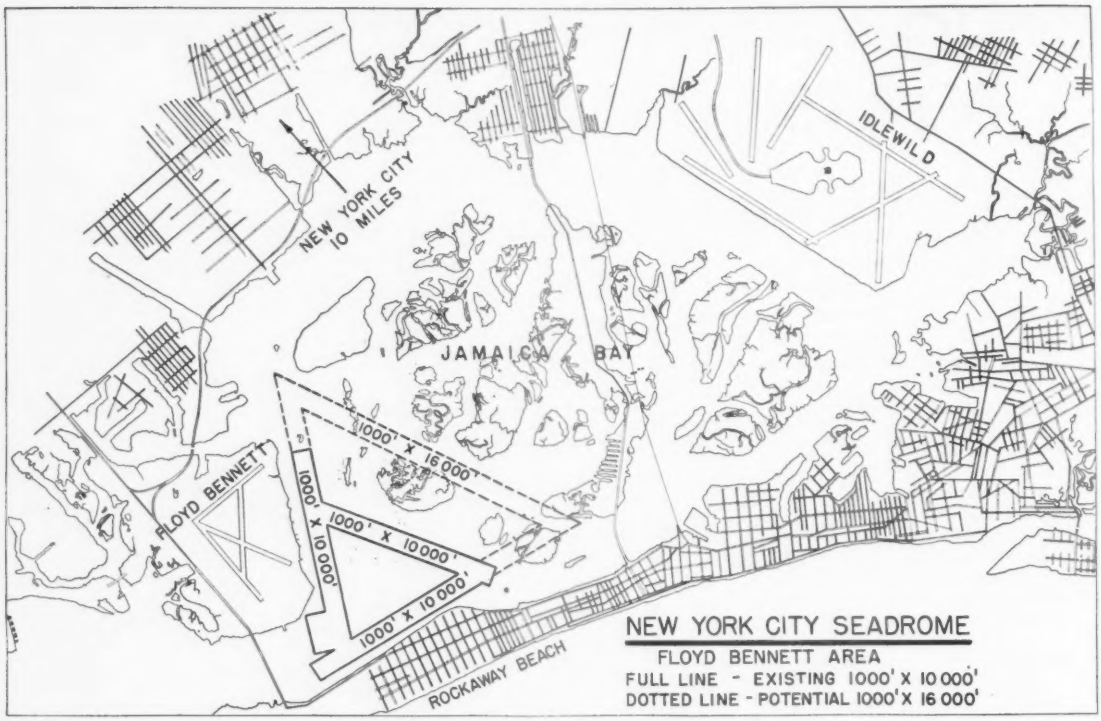
Flight Characteristics

The naval flying boat has a reputation of being inherently slow. There are some people who say it has no potential speed. Neither of these suppositions is true. It is a fact that early flying boats were not fast; however, that was a matter of self-imposed limitations. In those days the flying boat was purposely designed with a low wing loading to effect low-speed landings and take-offs. Usually the wing loading was not over 40 lbs. per sq.ft. The Catalina flying boats, for example, featured low

Presented at the Air Transport Meeting, I.A.S., Washington, D.C., October 25, 1945.

*The opinions expressed herein are those of the author and do not necessarily reflect those of the Navy Department.

†Captain, U.S.N.R. Coordinator, Project JRM.



wing loadings and were invaluable when engaged in rescue work at sea. Acting with PBMs under the nickname of "Dumbos," these "Cats" usually were angels of mercy for landplane crews who had been forced down in the open sea. Obviously, a slow landing and take-off speed permitted the Catalina to operate in higher seas than could aircraft with high wing loadings. Jet assisted take-off at high sea operation, of course, reduces the take-off time and distance no matter what the wing loading might be.

Another inherent characteristic of the early flying boat was a low hull loading coefficient, which normally was just eight-tenths. This characteristic, together with low wing loading, was a feature in the early Martin Mariner. With this design and a given hull beam, operational gross weight was limited to 46,000 lbs. Wartime experience has since pushed the gross weight of the Mariner up to 58,000 lbs. and even higher with a jet assisted take-off. Wing loadings also have gone up in proportion.

Design Trends

Today, a new trend in flying-boat design is in the making, a trend stimulated in no small measure by future military needs. The latest flying-boat design has a tendency toward high wing loading. In most cases this is equal to, or greater than, that of the newest landplanes. Higher wing loading means higher speed. This in turn opens the vista of greater distance covered in given time. Long-range search planes may thus sacrifice low landing or take-off speeds by operating from sheltered waters. Thus, they can be of higher wing loading than the relatively shorter range planes we had in the past war. This automatically spells longer ranges and more advanced search and scouting activity, whether tender-based or shore-based in the forward areas.

Operations

During the war the Navy used flying boats with low wing and high power loading. These aircraft operated successfully out of Saipan Harbor in the Pacific Campaign and also were effective in operations from open water areas to the west. They were used for search, rescue, and blockade, and they frequently operated from the open sea. They landed to save crews shot down by enemy operations or forced down in landplanes out of gas. They were up and down the coast of China, over the Yellow Sea, off Korea, and in the Sea of Japan, searching and attacking until the Rising Sun was seen no more. Soon Japan's shipping became so scarce that each sortie was nothing more than a routine flight.

Naval Requirements

The Navy's planned requirements for successful pursuit of the war included approximately 3,000 seaplanes and amphibians on hand and on order as of June 30, 1945. The cash value of this aerial armada amounted to approximately $1,225,000,000. No exact figures are available on the number of flying boats and amphibians maintained by the other two members of the Big Three. We do know that Great Britain used them extensively in the North and South Atlantic, around Australia, and in the Indian Ocean. We know, too, that Russia employed flying boats to guard her supply lines in the Arctic and off Eastern Siberia. Including the value of all of these Anglo-Russian aircraft, conservatively it may be estimated that the Allies had a total investment in flying boats and amphibians exceeding $2,000,000,000. This sum represents a reasonable portion of our overall expenditures in the winning of the war. Naturally, it is small in comparison to the outlay made for landplanes and the attendant landing fields. The military requirements for flying boats appears to have been significant in size even for patrol planes alone. Therefore, it might be concluded that flying boats cannot be eliminated from future military considerations. They will have a part in keeping the peace and in the preparedness program that we must ever mount upon our ramparts. Let us not forget that after World War I the use of poison gas was outlawed forever. Yet, we and our Allies continued to develop better gases to offset any action contemplated by an enemy power in that direction.

So it should be with the flying boat. Just because the war has ended, the United States cannot afford to neglect the military flying boat. Some day these aircraft may be instrumental in helping to prevent another war.

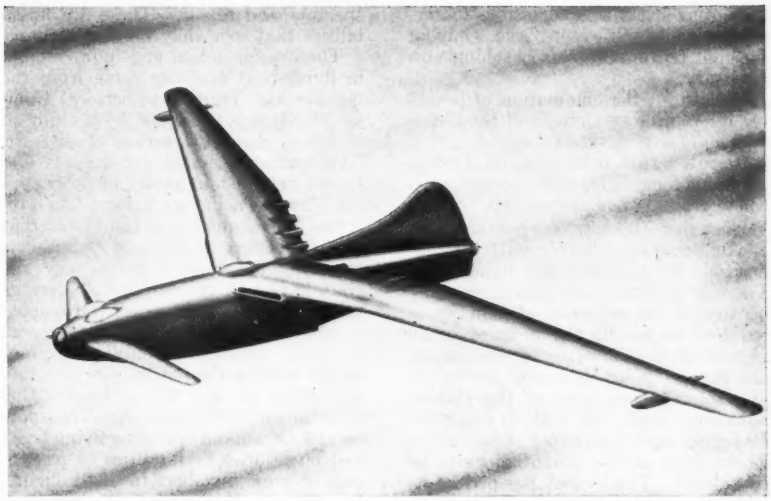
Development Potentialities

The flying boat has great potentialities for development as a long-range, high-altitude bomber. Any nation in possession of long-range flying-boat bombers can drop atomic bombs on any part of the world without acquiring additional territory, bases, or large air-

craft carriers. That is perhaps a broad statement, but visualize how easily it can be accomplished. It would only be necessary to coordinate the operation of the flying-boat bomber with those of refueling ships. These supply craft could even be other flying boats or possibly submarines stationed at predetermined points of rendezvous. An operation of this kind could be directed from any point in the world and could be expanded to cover the four corners of the globe. The supply ships could carry additional atomic bombs and missiles, as well as fuel. In this manner the rendezvous point could be shifted at will. Thus, by its ability to land at any place in the sea, the flying boat becomes a potential weapon that must be aggressively developed.

So far we have been considering the long-range flying-boat bomber as a purely offensive weapon. It has defensive potentialities, too. For instance, it could be used to help counter the threatened use of the atomic bomb against us. It could be employed to destroy the atomic-bomb-carrying enemy aircraft or launching locations. Likewise, a flying boat could seek out and destroy refueling vessels at sea and remain out on such missions for indefinite periods by means of that very tactic of refueling itself at sea.

Everyone is familiar with the operational record of the Martin Mars as a large-sized flying boat, or to put it another way, as a small flying ship. The Mars was originally designed in 1937 as a high-altitude long-range patrol bomber with a supercharged cabin. The Navy had much experimental work tied up in this one particular airplane. In addition to the pressurized cabin, it featured installations for cannon, racks to handle 30 1,000-lb. bombs, torpedoes, and new navigation instruments. Many of these devices were years ahead of our time. They were innovations in the van of such modern developments as precision bombing, power turrets, and the like. It is a matter of record that the Mars was, and is today, flying with the experimental type of engine that was ultimately developed to power the B-29. Unfortunately, perhaps, this engine was designed in the early days of the war when time did not permit further experimental work with it in the Mars. Already we were too late with too little. Because of man-power requirements for other essential projects and the immediate need for overseas air transport, the Mars, born as a patrol bomber, was converted into a transport. Looking back, we sometimes wonder what might have been if the vicissitudes of war had dictated otherwise. Perhaps the Mars, named for the God of War, could have been instrumental in developing a death blow to the heart of Japan. We know now that immediately after the fall of Saipan the Navy could have used a fleet of bombers like the original Mars to bomb Japan. Flying-boat bombers the size of the Mars could have been winging their way against Tokyo from Saipan Harbor in a matter of days after the island was secured. History tells us that it was almost 6 months later before the first B-29 soared off Saipan to drop fire bombs on Nippon, and with far less of a bomb tonnage than the Mars would have carried.



Flying ship bomber development. High speed—high altitude—jet propulsion.

The Flying Boat as a Transport

Now let us consider the flying boat as a transport. Paradoxically, the best example is this same Mars, as converted to a transport. This famous old plane was handicapped in transport work from the beginning by its low wing loading. As previously mentioned, this low wing loading was a Navy requirement in the development of the long-range patrol bomber designed in 1937. The Mars in 1942 completed a nonstop flight of 4,375 miles carrying 13,000 lbs. of cargo. If this cargo had been replaced by additional fuel, the Mars could have made a nonstop flight of 5,770 miles. Even so, this flying boat of 1937 vintage requires only four stops to complete a circuit of the world in the vicinity of the equator. Several refueling tenders or barges, with a capacity of 12,000 gal. each, were all that would have been required to do the job. Flying boats could make round-the-world flights before the war, and Pan American did it during the early days of the conflict when Clippers circled the globe westward from Australia in order to dodge the Jap-dominated Pacific. They came all the way home without the use of prepared landing fields.

Employment of the large flying ship should not be overlooked in any consideration of the development of American flag carriers in the international aerial trade. Rather it should be integrated into the broad program of our expansion in overseas commercial flying—not overemphasized perhaps, but certainly not sold short.

The Navy can be proud of its operation of the Mars. It is perhaps the first experimental airplane with a long flight record of usefulness. The Mars flew in the Atlantic and thereafter made an unparalleled utilization and load-carrying record in a regular schedule between San Francisco and Honolulu, carrying vital war cargo and passengers. Now, it is back in the Atlantic figuring prominently in an important training program. During the months of June, July, and August, the "Old Lady," as this craft is affectionately called by her crew, made approximately 600 landings and take-offs. This is no mean accomplishment, considering that all of these operations were under pilot-training conditions. It certainly speaks well for the ease of control and handling of the flying boat. Already the successor to the Mars, the new JRM is ready and is in the air. This flying boat is bigger and faster than the Mars, has greater cargo- and passenger-carrying capacity, and was tailor-made for transport work.

Development of Docking Facilities

Many new techniques in the handling of the Mars have been evolved as a result of the Navy's 2 years of transport operation with this big aircraft. For the most part, the search for improvements was actuated by the knowledge that new methods were needed to handle the large amount of cargo that this Mars-type ship can carry. Foremost among the innovations has been the development of a U-dock for speedy berthing. This dock at once facilitates the on- and off-loading of cargo and passengers and the servicing of the aircraft itself. Its vast three-sided platform area provides ample space for trucks to pull up alongside the open hatchways of the Mars. At the same time, it makes available adequate room for the erection of engine and prop workstands. Naturally, this eliminates the need for frequent beaching and increases the availability of the plane for flight operations. Docking procedures for guiding the big 74-ton boat into its slip have also been improved with practice. Today it takes just 7 or 8 min. for docking—a relatively short period of time—after a flight of 1,500 to 3,000 miles. So effective is the new dock from a maintenance standpoint that almost

the entire aircraft is accessible to mechanics while still water-borne. Only for the hull bottom work is beaching now necessary.

Because of the elimination of beaching for routine servicing and the development of new methods of servicing, it is anticipated that utilization on a route involving long flights will average somewhere around 12 hours per day.

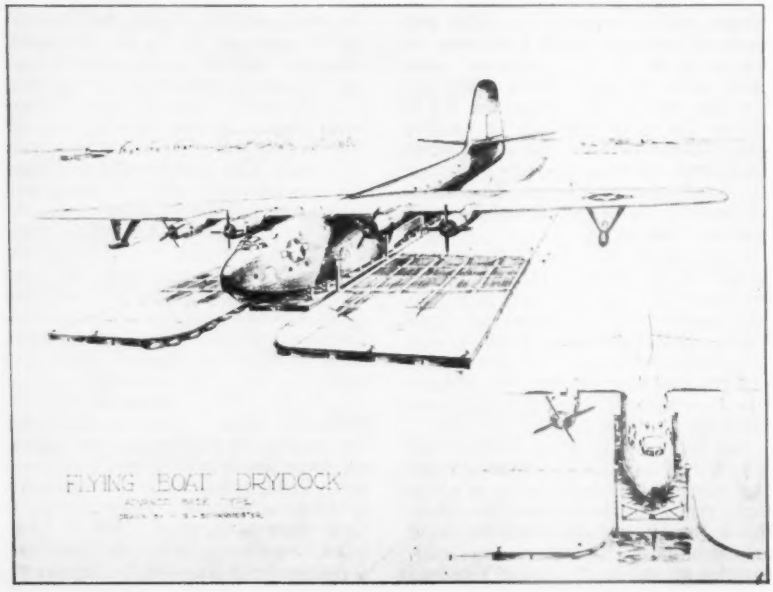
In many ways, the development of docking facilities has opened up new horizons for the transport flying boat. There is the immediate gain in economy because of the reduction of man power required to handle the mooring of an aircraft of Mars dimensions. No longer are many-handed beaching crews required. The principles of the U-dock have outmoded them with no negligible saving in payroll and cost of operation. Then, there are the potentialities to be considered. The U-dock has proved itself in principle. Its possibilities are unlimited. It could be used as a mooring for flying boats up to 500,000 lbs.—merely increase the size of the dock! In the world of tomorrow, it seems perfectly plausible to picture U-docks capable of handling flying boats of all sizes, ranging from 50 to 500 tons, in much the same manner that, today, the same steamship dock is used for the Queen Mary or a Hudson River dayliner.

Visualize with me this flying boat dock of another year. It will be the modern traffic and maintenance terminal. Perhaps two or three decks high. Terminal and traffic facilities with cafes and cocktail lounges and other comforts of a modern hotel will occupy the upper decks. Elevators will provide easy access to the lower levels where the most modern maintenance equipment will be concentrated. Escalators will speed baggage up to the traffic counters, and electric hoists will quickly off-board cargo. Perhaps the touch of a button will start pumps into action to provide a drydock for hull inspection and repair. These are possibilities that soon may become realities.

The cry for action and improvement in flying-boat facilities came from the Naval Air Transport Service Command. It was prompted by a study of N.A.T.S. daily utilization of aircraft. This service operates flying boats and landplanes predominantly in support of the Navy's Pacific operations. As a result of the survey it was discovered that the converted flying-boat transports originally constructed as military aircraft have had greater overall average utilization than landplanes constructed in accordance with standard transport design. This little-publicized fact speaks well for the possibilities of future utilization of the flying boat. One squadron of the Naval Air Transport Service Command operating flying boats had no injuries or fatalities to passengers or crew members in 4,291 flights. In amassing this record, the squadron flew 40,322 hours and carried over 68,000 passengers a distance of 55,000,000 passenger-miles.

Safety

Compared with landplanes operating over the sea, the flying boat has a remarkable safety record. It is a well-known fact that a relatively high percentage of passenger and crew fatalities has been experienced in landplanes forced down at sea. Similar losses as a result of seaplane accidents are small. Always, there has been a greater chance for survival. In fact, most of the flying-boat accidents have occurred in operating areas in the vicinity of terminals. Here, it is only fair to interpose the comment that no real effort has been made to equip properly our seadromes. The majority of landing and take-off areas for flying boats are antiquated, as far as lighting and seadrome landing laws are concerned. By comparison to airfield lighting, the landing lanes in the majority of seadromes are of 1930 vintage. There is not a modern flying-boat terminal in the United States commensurate with the seadrome facilities designed and installed during the war at Honolulu, Johnston, or Canton Islands. All of these were developed principally for N.A.T.S. use, with a small percentage of the money value that must be invested in the making of airfields capable of handling landplanes of a gross weight sufficient for international traffic.



International Operations

There exists today a little-known and little-used natural seadrome at Floyd Bennett Field in New York. There are three 10,000-ft. runways available which could be put to instant use for flying-boat operation. This area is the same distance from New York City as is La-Guardia Field and the new Idlewild airport. Last winter there were only 3 days when this area could not be used by seaplanes, and on these davs Baltimore, 1 hour away, was available as an alternate. In passing, it should be mentioned that the New York area is the only thickly populated part of the world through which international air commerce will flow where flying-boat operations may at times be interrupted for a few days of the year due to icing conditions.

The British have long been known as a dominant maritime power. Their preeminent position in world trade is due in no small measure to their highly developed merchant marine. Today, commerce-wise Britain is developing the flying boat to parallel its international landplane operation. Undoubtedly, the British are weighing the flexibility of the flying boat, which uses the natural waters of the world, and the coming inflexibility of the landplane because of its increase in size. It is a fact that as flying boats become larger, their flexibility increases in direct contrast to the decreasing flexibility of the large landplane.

Efficiency

Preliminary research today indicates that the flying boat or flying ship will become more efficient than the landplane. The high wing loading, more efficient flap design, and power plants embodying the gas turbine principle or the use of jet and atomic power for propulsion can be applied to flying ships as well as to landplanes. Data have already been obtained indicating the great improvement in flying ship hull forms. In these, hull beam loadings will greatly increase, in some cases up to 250 per cent. The tendency will be toward narrower but much longer hull forms in contrast to the present wide but short hulls. Improvements in this direction reduce cross-sectional areas with drag reduction gradually approaching the streamlined fuselage of the landplane. The United States must promote this development work. The stake is a military as well as a commercial one. For the Navy must have proper air support, both in search aircraft and in

high-altitude bombers operating from water areas. Funds must be forthcoming to increase the usefulness and efficiency of the flying boat. Research along these lines must go ahead unimpeded in this country. You may be sure our neighbor nations will not neglect it.

Speed and Comfort

Air travel must provide comfort. For landplanes, this means an increase in fuselage volume equal to that of the hull of the flying boat in the higher gross weights. With equal hull volume, equal wing loading, and power provided by the same power plant, the difference in high speed is only about 4 per cent in favor of the landplane. Speeds of 400 and 500 m.p.h. in flying ships will be only slightly less than that of the landplane with similar accommodations. Already the greater load-carrying efficiency lies with a moderate-size flying ship. This is due to approximately an 8 per cent greater useful load than that of the landplane. In the still larger aircraft of the 400,000-lb. class the difference amounts to 12 per cent. This differential in useful load enables the flying boat to carry a greater pay load than the landplane. The differential in pay load is greater over long ranges; at the optimum range of the landplane, where the useful load is zero, the flying boat of the same gross weight carries a substantial useful load. This greater useful load of the flying boat will be an active factor in producing the lower cost, long-range air transportation.

Low-Cost Transportation

Recently, one of England's air-transport officials remarked: "India is now only 16 hours from England, but what good is that if the cost of transportation is so high that no one can use it?" To survive and expand, air transportation must reduce the cost to the shipper. The bulk of the world's cargo will still move by surface, either by rail or, internationally, on the seas. In international shipping, formerly one of the most competitive of trades, relatively small difference in cost and payability were often decisive factors. The British built up and maintained the world supremacy of her mercantile marine for a great many years on just such small differentials of cost and loading.

The flying ship can produce low-cost transportation for international purposes. However, we must not look solely to the United States for customers to fill our international carriers. We must be able to offer to the rest of the world low-cost transportation to the United States for both personnel and cargo. The world is apparently financially embarrassed, judging from the credits it is trying to obtain from us. Here is a clear-cut indication that, unless air transport rates are exceptionally low, American air carriers will not be able to obtain traffic from the rest of the world. This condition will obtain even though our own national interest may absorb operational costs.

The Navy's Marianas Mars in loading and servicing dock.

Foreign Development

As mentioned previously, the British, always recognized as maritime leaders, are going ahead with development of the flying boat. In some cases, they are paralleling their landplane routes. Today they are encouraging competition among types in order to permit their people to have the cheapest form of air transportation possible. This competition between types will definitely bring down the costs of air transportation. In connection with the British use of the flying boat, it is interesting to note that they can operate throughout the world using their far-flung colonies as stepping stones. Any place in the Empire where the British Navy or British Merchant Marine has sailed is open to British-operated flying ships. No new costs are involved because no land fields need to be developed in those areas. The waters are ready to receive the flying boat anywhere and at any time.

Russia, too, is coming into the international picture. She has obtained ice-free Port Arthur. According to press reports, the Soviet is also interested in obtaining ports on the Red Sea and on the Mediterranean. There is also talk that Stalin is interested in the development of a modern navy. With this thinking, Russia is no doubt looking toward a future position in international commerce. Whether she will use landplanes or flying boats is hard for us to say at this time. Therefore, we must go ahead and prepare to hold our own in a highly competitive field. For speed, which goes hand-in-hand with higher prices, we should develop the landplane. For only slightly less speed but lower prices and to meet the threat of international competition, we should also develop the flying boat.

Conclusions

With some foreign nations integrating the use of the flying ship in their international transport and shipping routes, the United States would be shortsighted not to encourage its use along similar lines. Consideration might be given to a program whereby steamship companies could operate flying ships as auxiliaries in supplement to their own existing routes. While this suggestion would restrict the steamship companies to the use of the water-borne aircraft, it would still be beneficial to the United States for maintenance of a pre-eminent position in international sky commerce. We have found practical experience ahead of us instead of behind us on so many occasions that such a move would certainly be in the national interest. If there is to be another war, our plans must be directed to the speedy transportation overseas of whole armies by air instead of merely air support. The large flying ship seems to be the solution to such transport problems, for it is doubtful if prepared fields will be available to accommodate the aircraft required, either in size or in number.

To maintain our power in the skies, we must continue as pioneers in research and development. As the Under-Secretary of the Navy said recently: "The atomic bomb must still be carried close to its objective—at least for 10 years to come." In the future, it may be possible to perfect a controlled missile, but whether such a missile will be long range, eliminating necessity for its being carried to an objective, is a matter for the future to determine.

I do not believe that the atomic bomb can destroy landing areas such as Chesapeake Bay, San Francisco Harbor, Saipan Harbor, and innumerable other waterways of the world as easily as that bomb may render useless the airfields required for the operation of our large landplanes. Yet, the atomic bomb must be carried in some manner—self-propelled or by aircraft, either flying ship or landplane. Certainly we cannot afford to put all of our eggs in one basket and gamble that the controlled missile or the landplane will be the answer. The flying boat operating from the natural waterways of the world has an advantage peculiar to itself which should make mandatory its inclusion in any of our future military plans, which must include a well-rounded overseas commercial air transport service.

Only through the stimulation of research and development can we procure the best results. These results must be

(*Continued on page 109*)

Itinerant Aircraft Radio

H. T. SAGERT*

Lear, Incorporated

SUMMARY

An analysis and review of a subject about which there has been a dearth of authentic information and which, in view of the impetus to postwar itinerant flying, is especially timely.

Relationships between the individual pilot and the type of aircraft, the nature of his flight operations, the selection of his radio and accessories, as well as maintenance and service facilities available are presented.

Explanations readily understood are given on the why's and wherefore's of antenna and power requirements. Electrical and mechanical installation considerations are presented with suggestions for the operation and care of the equipment. A simplified explanation of the Federal Communication Commission's requirements for aircraft radio station licenses is included.

A preview of the bright prospects that V.H.F. radio promises to personal aircraft radio concludes the paper.

INTRODUCTION

FOR SOME TIME NOW scheduled air-line communications have attained close to 100 per cent efficiency in their communications operations. Non-scheduled itinerant radio communications, not having the advantages of concentrated organization and development, have not enjoyed such success.

Unlike the air-line pilots whose radio contacts are backed up with minimum training, standardized installations, and routine maintenance, the civilian pilot's ability and equipment may range from that of a student making one of his first cross-country trips in a dry-battery radio-equipped tandem trainer to that of the professional instrument-rated pilot flying a multiengined craft with all the instruments that money can buy.

The outstanding differences in the flight operations of the air lines as compared with those of the itinerant pilot contribute considerably to their relative results. Considering the day-in and day-out operation on the same airway routes of the scheduled air lines against that of the "liable-to-be-anywhere" on-or-off-the-airways' operations of the private pilot, it is easy to account for variance in the results obtained.

The air lines early in their growth foresaw the wisdom of working out their radio problems through the medium of the organization of Aeronautical Radio, Inc. This nonprofit, mutually operated organization has coordinated the needs and assisted in working out the myriad problems encountered by the nation's air lines, but the individual nonscheduled operator or pilot has not directly received such organized assistance and guidance.

The Department of Commerce through the Civil Aeronautics Administration and its predecessors has contributed immeasurably to the facilities available to the itinerant pilot. The normal competitive spirit of the limited number of aircraft radio manufacturers has also brought about some progress in itinerant aircraft radio. However, until recently little coordinated effort has been made to solve these problems and bring about standardization of equipment, its installation and maintenance, and the general education of the individual pilot toward an understanding of the limitations as well as the possibilities of performance in the wide variety of radio apparatus to be found in an equally wide variety of aircraft.

If we are to give the individual user the maximum dependability and utility in his radio communications and navigation equipment, now is the time for some of us to organize standards, for others to improve technical features, and for the pilot to adopt a standard of care in the operation of his equipment.

SELECTION OF THE EQUIPMENT

In the past, as a certain piece of apparatus was needed, the selections of the pilot or owner would be governed by factors that did not always lend themselves to the best working combination, minimum weight, simplicity of operation, or, *more important*, to optimum maintenance and service. Particularly in the case of added accessories has this unwise practice spread to itinerant aircraft radio.

Basically, the choice of equipment is governed by (1) the type of aircraft, and (2) the nature of its flight operations.

Obviously, the selection of equipment for a multiengined craft with large electric power resources is at the other extreme from that for a light side-by-side private plane. Likewise, the high-powered transmitter, automatic direction-finding and instrument flight radio equipment of the former differ considerably from the battery-powered receiver of the latter, which may be used merely for control-tower reception on training flights. Yet both may be itinerant craft and affected to proportionate degrees by the same factors.

At the start the factors mentioned above introduce certain physical limitations in the electrical power and mechanical considerations which bear upon the final equipment selection. These physical limitations also introduce definite operating limits that are not always appreciated by itinerant pilots. As a matter of fact, they have not always been appreciated by some radio engineers.

As pointed out, the actual flight operations will govern to a major degree the type and extent of radio needed. C.A.A. regulations dictate certain minimums of equipment and/or their performance for some such flight operations. In other cases, usage soon makes apparent the type of equipment needed.

Progressive planning in the selection of itinerant aircraft radio will pay dividends, and the personal aircraft owner will reap maximum benefits in convenience, safety, and financial savings when added equipment and accessories are matched and intended to complement the units previously installed. This is especially true in the addition of direction-finding loops, simultaneous range filters, headphones, microphones, etc.

Thus, when the student pilot, who has worn a groove in the traffic pattern around his local field and has tucked several cross-country trips under his belt, decides he would like to listen to radio beams and weather reports on his next trip, he can exercise his best judgment by choosing a multiple band portable receiver. If he does so, he has a radio with considerable utility, for in addition to introducing him to the use of aircraft radio for communication and navigation, it will enable him to listen to other aircraft and ground stations, in this manner familiarizing him with aviation communication procedures. Other airport uses, such as for obtaining preflight weather broadcasts, general broadcast entertainment, and aircraft monitoring add to the many features of the aircraft-type portable.

If for any reason the buyer of a new airplane elects to install only a part of the equipment he may finally need, it is important that he choose radio to which additional units or accessories may be added with a minimum of cost and weight and a maximum of utility.

In the past, itinerant aircraft radio has been costly; however, it has not

---

Presented at the Light Aircraft Meeting, I.A.S., Detroit, October 4–5, 1945.

*Sales Manager.

been so without foundation. Extensive developmental, engineering, advertising, field service costs, as well as numerous hidden costs peculiar to the aircraft radio business, have had to be charged against comparatively small production, resulting in their being jokingly termed "aircraft prices."

As developmental costs become generally absorbed and production becomes appreciably greater in the future, lower-priced apparatus are in prospect. However, it is doubtful if the original cost will be of prime importance in the selection of such equipment.

The basic factors mentioned previously and the following requirements and considerations will control the selection of itinerant aircraft radio and otherwise generally affect the results attained.

Power Requirements

Throughout all considerations of what radio equipment to use in any particular aircraft, one is continually confronted with the previously mentioned matter of physical limitations. This is outstandingly so with regard to the primary power requirements demanded by various electronic communications and navigation equipment.

Because more and more personal aircraft accessories are being electrically operated, it is important to remember that only a portion of the ship's battery power is available for radio equipment.

Receiver power requirements are not unduly large, even for receivers with quite a number of vacuum tubes. This is true because the voltages and currents used in the plate circuits of such receivers are not high, the plate voltage usually not being in excess of 180 volts and more often appreciably lower. By the same token, the currents in such circuits are on the order of a few milliamperes.

Receiver operation may be had even with plate potentials as low as the 24 volts that are available directly from some aircraft battery systems; these would not require bulky and power-consuming power units. However, the apparent desirability of using such a system is somewhat reduced, because any ship carrying such a battery system would undoubtedly require a transmitter which, because of its higher voltage and current needs, would necessitate a high voltage power unit. Such a power unit being needed, it might as well be utilized to furnish power for the receiver. Its alternate receiver-transmitter operations add essentially no weight and little additional cost.

Transmitter power demands from the battery are medium to large and are almost directly related to the rated radio frequency power outputs of the transmitter. Aircraft transmitters with radio frequency outputs appreciably less than five watts do not have the capabilities of coping with actual aircraft communication conditions existing on the currently used frequencies. It is true that fair results are obtained with transmitters that have outputs as low as one-half watt for local airport contacts, but for the itinerant pilot relying on his radio transmitter for normal communications encountered in cross-country operations such equipment has proved to be inadequate.

Dry Batteries

The answer to the question "how far is it desirable to go in the use of dry-battery operated aircraft radio," is governed by the power limitations of dry batteries in practicable physical dimensions and weights. There is also the uncertainty of remaining battery life. If the individual's flight operations are such that he will be satisfied with "half a loaf," it can be said that good receiving and direction-finding results can be had with this type of equipment. The addition of an aural-null type loop antenna does not make additional power demands upon the receiver batteries. Later, when the user of a dry-battery receiver requires a transmitter for his operations, he will find after a little use of a dry-battery operated aircraft transmitter that the performance and dependability he needs is not there.

Wet Batteries

The next step is the use of wet electrolytic type storage batteries. Such batteries for aircraft use are of 6-, 12-, or 24-volt potentials with power outputs limited only by the weight-carrying capabilities of the aircraft. Storage battery use immediately requires a charging generator that, in turn, introduces additional weight, maintenance, and economic problems.

There are certain definite relationships between the voltage of a storage battery, its power available in wattage (usually designated in amp.-hours), and the relative currents likely to flow in the connecting circuits. These relationships are governed by Ohm's law which says, in lay terms, that in a 6-volt electrical or radio accessory requiring 60 watts of power, a current of 10 amp. will flow in the connecting wires. By the same law, a 12-volt unit still requiring the same 60 watts will have only 5 amp., or one-half of the current flowing in its connecting wires. Carrying the physical laws further, one finds that where losses might occur, for example, in the length of battery leads, such losses are twice as great in the 6-volt system with its 10-amp. currents than in the 12-volt system with its 5-amp. current.

By a similar physical relation, it is known that the larger the current flowing in the electrical circuit the larger (and the heavier) the conducting wire that is needed to prevent excessive losses. In short, out of these factors it can be seen that there exists an optimum-voltage battery system for aircraft determined by whether the craft is in the light, medium, or heavy class.

Standard Voltages

Undoubtedly, standards for ideal battery voltage will be adopted shortly. In lieu of such standards, the general picture is as follows: Early air-line battery systems used 12 volts but it was not long before the quantity of electrical equipment necessitated 24 volts to keep down losses and weights. Almost all multiengined aircraft use the 24-volt system, although some of the smaller twin-engined types are able to get along with 12 volts.

Single-engined, personal aircraft generally are using 12-volt systems, although some of the lighter planes used 6-volt systems without worthwhile gain and with some losses, and they returned to the 12-volt system when electrical equipment was added. Thus, the trend is to 12-volt systems in single-engined

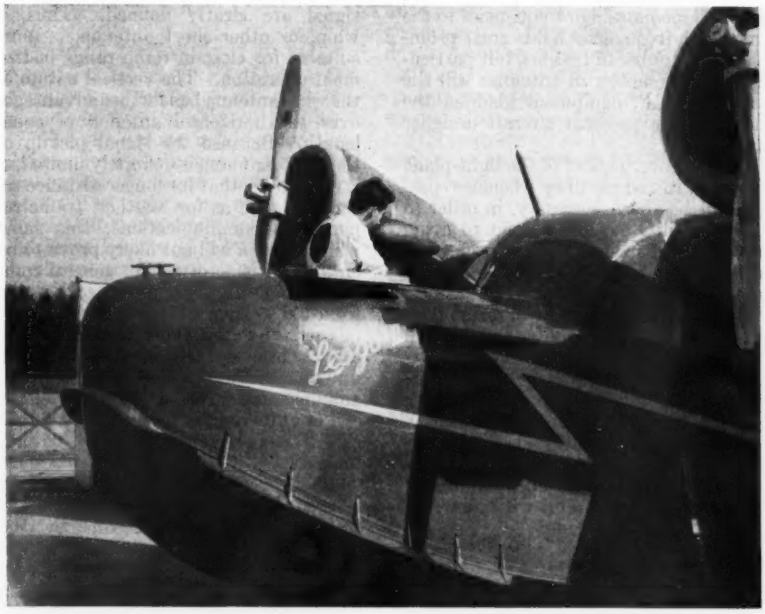


Fig. 1. The most important single contributing factor to the success of itinerant radio is the original installation. Maintenance and service follow in sequence.

Fig. 2. For proper servicing, facilities like this are necessary. One large manufacturer is urging its distributors to install such departments at airports across the country.

civilian airplanes and 24-volt in twin-engined types. Where an exceptional electrical power is required for some reason, single-engined ships usually go to 24 volts. The Noorduyn Norseman "work horse" is a good example of this. While there is a possibility that electronic equipment development may make the use of a 24-volt or higher battery desirable in light aircraft, this does not appear to be so at the moment.

Antennas

The transition of aviation communications from the currently used low and medium-high frequencies to the very high frequencies holds great promise for a number of reasons, but particularly in the matter of antennas will the use of V.H.F. equipment gladden the heart of the personal aircraft designer and pilot.

Despite every effort of the light-plane designer to reduce drag whenever possible, it has been necessary, in order to get any utility out of the radio, to string a variety of unsightly, drag-increasing antenna masts, wire, and other fittings all over the fuselage and the wings. Eventually all of these will go and instead there will appear small, thin "feeler-like" antennas. Even the mysterious looking "teardrop" loop housings and rotatable aluminum tubing loops will become a thing of the past.

This change will not take place overnight. In the meantime, there is considerable need for an understanding of the following why's and wherefore's of aircraft antenna systems.

Receiving Antenna

Generally speaking, the function of receiving antennas is that of a pickup source or sense element for the radio frequency energy being received from the transmitting station. With the high gain performance of modern receivers, which permit the amplifying of even small amounts of radio frequency signal energy, a short ship antenna suffices. From this it can be seen that receivers do not require resonant physical length antennas as do transmitters.

With aircraft flying through an electromagnetic field of radio frequency energy being radiated from, for example, a standard radio-range station, the signal thereby being picked up on a short whip antenna has the apparent result of being sharp. In other words, the on-and-off-course components of the beam signal are clearly defined. Thus, a whip, or other short antenna, is most suitable for close-in radio range instrument operation. The vertical nature of the whip antenna has further advantages over the horizontal antenna of equal length. Because the signal pickup of the whip antenna is definitely limited, it is easy to see that for longer distance reception, such as for weather, traffic reports, or communications, this same whip antenna will not likely prove to be entirely satisfactory. For general communications at any appreciable distance from the station, a longer antenna must be used. Usually, this takes the form of a horizontal antenna either overhead or underneath the fuselage. Further, this antenna may have its lead-in at either end or at its electrical center. These are called, respectively, "L" or "T" antennas.

If an even longer receiving antenna is needed it is possible to utilize the trailing transmitting antenna by the proper use of switches and/or relays. When this arrangement is made, care should be exercised that such an antenna is not used for instrument operation, because too broad and even erroneous signals may be received.

Transmitting Antenna

Transmitting antenna performances are directly related to certain physical dimensions dictated by the frequencies being used. The maximum radiating efficiency of transmitting antennas is had when a certain fractional, resonant physical length is reached. Stated otherwise, it is when the antenna may be said to be "in tune." This resonant length happens to be inverse to the frequency of the transmitter, which, in turn, means that the higher the frequency on which a transmitter operates, the shorter the antenna will be to resonate and have a given efficiency.

The function of a transmitting antenna is exactly the opposite to that of the receiving antenna—its task is to radiate or transmit the energy developed by the transmitter, and to do that best an antenna is required appreciably longer than may be permanently fixed on the aircraft. This necessitates the trailing antenna with its inconveniences. At the itinerant aircraft transmitting frequency of 3,105 kc., the length of such a trailing antenna should be in the neighborhood of 75 ft., from transmitter to the end of the antenna. For 6,210 kc., the itinerant daylight and generally greater distance frequency, approximately one-half the antenna length is required for equal resonance.

It is the author's opinion that considerably greater use of 6,210 kc. can be made with much better results by light aircraft in view of their predominantly daylight flight operations.

The trailing antenna with the retractable reel is not too awkward to handle under slow and medium cruising speeds. Under local airport traffic conditions it is desirable to reel in the antenna, and if its installation is such that a portion of the antenna is still available, it is then necessary to add loading coil to the remaining portion of the antenna to make up for the portion that has been retracted.

If the trailing antenna is of the type that releases through the belly of the fuselage, it is necessary to switch the transmitter over to a separate, fixed antenna that likewise has been loaded to be the equivalent of the retracted antenna.

Because of the inefficient radiation characteristics of the load coil in the short fixed antenna, the range of the transmitter becomes appreciably less. An idea of the communicating range of the two antennas may be seen in that a transmitter that will transmit a maximum distance of 75 miles in a trailing antenna will have approximately a 15-mile range on an average, loaded, fixed antenna.

F.C.C. Licensing Requirements

Inasmuch as some of the activities of the Federal Communications Commission have been tied in with precedences established in certain slow-moving functions, such as marine communications, it is easy to see why we, who have wanted our radio for rapid-fire control tower contacts a few minutes or seconds

before a landing, have not had much patience with the seemingly unnecessary red tape preliminary to obtaining an aircraft radio station license, not to mention the numerous, not too easily performed chores that have to be done to retain it.

In a limited defense of some of the requests made by this agency, it must be admitted that practically each one had some foundation. They were simply too cumbersome for our youthful and fast-moving industry. It is to the credit of the F.C.C. that of late they have been loosening up the yoke for us. Undoubtedly, with understanding and sincerely presented constructive criticism on our part, they will extend further mutually beneficial cooperation.

In the meantime, a review of the responsibilities of an aircraft radio station licensee will simplify our task. Anyone who is allergic to detail will have trouble getting past the original F.C.C. Form 404, the Aircraft Radio Station License Application; however, a determination to answer all questions, even to putting dashes in the answer spaces to the questions that do not apply, to indicate that they were not overlooked, will usually result in a prompt acknowledgment of receipt of the application, and shortly thereafter (particularly if the equipment being used is standard) a station license will be issued.

From there on it will be necessary only to adhere to the following items each year for the license to be reissued:

(a) The transmitter licensed must be operated only by the holder of at least a Restricted Radiotelephone Operator's Permit.

(b) A report of frequency measurement is required to be conspicuously posted in the aircraft to indicate that the assigned transmitter frequencies were checked and found to be within the tolerances specified on the license sometime within the previous 6-months' period. This frequency measurement must also be made immediately after original installation.

(c) The aircraft radio station must be inspected at least once during each license period (which is 1 year). The F.C.C. field inspectors make these inspections (usually at one or more airports in the vicinity of their branch offices in major cities). They have set aside two periods during the year when they attempt to concentrate their efforts on aircraft installations. These periods are the week beginning the first Monday in May and the week beginning the first Monday in October. Arrangements may be made with any F.C.C. Field Inspector-in-Charge for an inspection to be made during either of these periods. If for any reason the licensee is unable to have his station inspected during the above times, he may make arrangements for an inspection at any other time mutually convenient to himself and the field inspectors of the F.C.C.

Before presenting the station for inspection, the licensee should be certain that the frequency measurements' reports and the station license are properly posted. Equally important is the fact that the equipment as licensed is actually the equipment that is installed in the plane. If the pilot presenting a station for inspection uses the transmitter, the inspector will want to see his Operator's License.

(d) Applications for aircraft radio station renewal should be submitted 60 days prior to the expiration date of the license in order that sufficient time may be allowed for renewal of the license.

(e) Immediately upon change of ownership an Aircraft Radio Station License Transfer Application should be submitted.

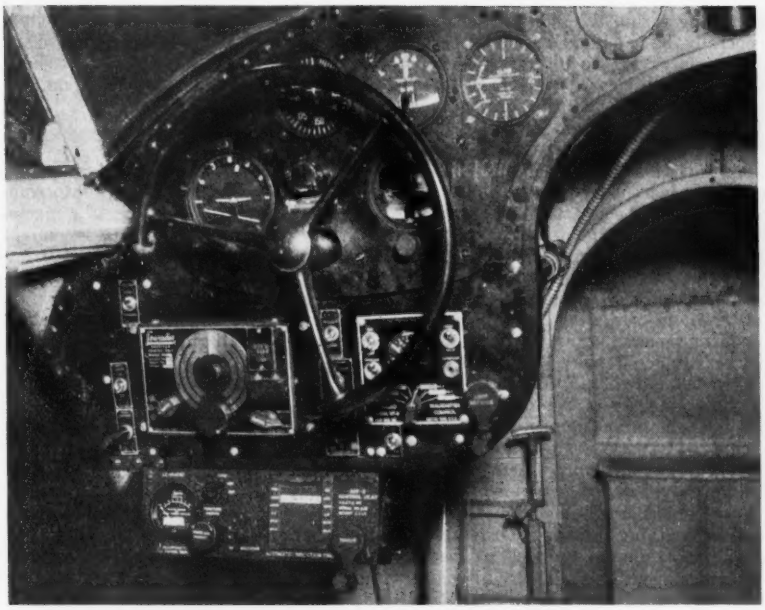


Fig. 3. In some of the larger ships, installations like this are often found, including receivers, transmitters, and automatic direction finders.

Installation

The most important single element contributing to the degree of success of itinerant radio is the original installation. The variations possible in installing a comparatively simple transmitter-receiver combination are almost unbelievable. The equipment may be installed by an apprentice mechanic; an A and E mechanic with a job to do but without any understanding of electrical equipment, much less radio. It may be by a radio enthusiast whose friends say, "He fixed my home radio after all the radio shops in town failed"; or perhaps it was an aircraft factory installation. In the past the latter was no guarantee of the best installation, since the aircraft manufacturer was primarily in the business of building and selling airplanes and the installation of radio was a necessary accommodation.

It is true that a fair amount of data has been gathered about aircraft radio but this has been almost entirely pertaining to air-line applications. For the most part, little, if any, tangible (performance) data is available on radio in a tubular-fabric or plywood fuselage.

If, in addition to a questionable installation, there is a lack of preventive maintenance and possibly uncertain knowledge of correct operation and appreciation of facilities, it is easy to account for the problems of itinerant aircraft radio.

The quality of installation is directly a matter of the experience and the integrity of the individual doing the work. While radio installations are approved by the C.A.A.'s general inspection group, it is done so from a standpoint of weight and balance of the aircraft and its airworthiness.

The only proof of a good installation of aircraft radio can be found in flight-checking it and in a period of shake-down. Almost any aircraft radio installation will work on the ground, but its true test is in its working when it is needed most—when the aircraft is cruising through the air at 100 to 200 m.p.h., and, even more important, when radio reception conditions are not always at their best.

Equipment Layout

Considerable thought must be given to the layout of the equipment prior to the installation. Convenience to the pilot is not the only consideration in the placement of receiver and transmitter controls. The electrical and mechanical effects of such units on other controls and instruments must be considered. For example, if the receiver tuner were to be mounted close to the ignition switch, or if its antenna leads paralleled ignition leads, even though the switch and leads were shielded, there might be considerable ignition interference. The placement of either the radio units or their wiring might excessively affect the magnetic compass, and so forth.

Units of the radio equipment, such as power supplies, which do not require

mounting within the pilot's reach, may generally be mounted in a number of other places in the aircraft. Usually these units are located to the best advantage of weight distribution in the plane. The choice of location is governed by the existing weight and balance conditions that will allow the center of gravity to be located within the c.g. limits permitted for the particular airplane. Baggage compartments, floors, spaces under seats, and, in some cases, specially built shelves in the rear of the fuselage are some of the possible locations for these out-of-the-way items. It is to be recommended, however, that they not be installed in places too inaccessible for service, nor should they be mounted on the engine side of the fire wall where oil and gas may damage them. It should not be necessary to point out that "too good" a mechanical mounting cannot be provided.

Some mechanical locking devices, such as safetying, Elastic Stop Nuts, or other means should be used to insure mechanical security. Both mechanically and electrically, the installation should be one of the most important points of every routine overhaul or inspection given the aircraft.

Circuit Wiring

The importance of good workmanship practices in electrical wiring is obvious. Briefly, all circuits should be wired with wire large enough to handle the electric current required by the equipment being installed. Proper fusing of each unit is required. Electrical and mechanical cables must be securely fastened. Shielded cables and metal-cased mechanical cables must have the necessary bonding. Extreme care should be taken in making each electrical connection, whether it is soldered or the lug type held in place by lock washers and nuts. All of these connections should likewise be closely inspected from time to time.

Shielding

Considerable time and thought have been given to the possibility of reducing or eliminating the costly ignition shielding required on light aircraft engines, but up to the moment the simplest, lowest-cost, and most dependable solution to this problem is still the entire shielding of the high-tension, secondary wiring, including the use of shielded spark plugs, and in most cases, the entire primary ignition switching circuit. Because of the low power, as well as the frequencies used by ground stations, the use of headphones for reception, plus the construction of the aircraft, this problem is somewhat different from that of auto radio broadcast reception where full shielding was readily sidestepped.

Perhaps new channels of the radio spectrum to be used; new developments, such as the recently developed low voltage (1,200 volts) high frequency (2,000,-000 cycles) ignition systems; or some other outstanding improvement may help accomplish this matter of the elimination of complete shielding.

No attempt has been made herein to cover all of the details of installation and only some of the most prevalent shortcomings have been touched upon.

Operation of the Equipment

How to operate your radio equipment to obtain the best results in both communication and navigation is a matter about which a separate paper might readily be written. However, it is important to point out here that an intelligent understanding of the operation of the equipment is equally as important as correct installation and maintenance.

The pilot does not often appreciate the fact that the operation of the radio communications system in his airplane is not so simple, nor are the results so certain as his office telephone. Neither does he at all times appreciate that in addition to the variable man-made factors affecting the results, there are certain inherent characteristics in the behavior of radio signals that are not always conducive to perfect results.

A number of cases of supposed equipment failures have turned out to be pilot misunderstanding of even the elementary use of the equipment. A little "dual" in the rudiments, as well as the fine points of the operation of the radio equipment, will pay dividends to every pilot—most certainly it will do so when the going gets tough.

Itinerant aircraft communication as reliable and as satisfactory as telephone communication is not much further off than the immediate postwar period, and if we want to peer even a little farther ahead, it is possible to visualize virtual push-button aircraft operation by radio and other automatic devices. By tying in the function of an automatic radio compass with an automatic pilot and a few other devices, such radio-controlled flight is feasible today.

Maintenance and Service

On the foundation of proper installation rests the need for efficient maintenance and servicing of the radio. These have been decidedly lacking and available only at scattered points. Preventive maintenance and periodic overhaul for such equipment almost do not exist in nonscheduled radio and accordingly are reflected in the results obtained.

Much of the success of air-line communications has been the result of the systems of routine overhaul practiced by most air-transport companies. The author, with 15 consecutive years of daily experience in itinerant radio, has attempted at numerous times to sell the idea of routine maintenance to different individuals and operators, particularly during the Civilian Pilot Training controlled cross-country programs, when the use of such equipment had a semblance of formal operation.

Like numerous other variable factors controlling the degree of success of itinerant communications, there are reasons why preventive maintenance and periodic overhaul of nonscheduled aircraft radio are not easily accomplished. Such factors as inconvenience to the limited sources of radio service and a lack of appreciation of the value of radio when it is working properly, contribute to passing off the duty of maintaining the radio. Because of increasing traffic conditions the need for dependable communications by nonscheduled operators and civilian pilots emphasizes the importance of routine preventive maintenance for their operations.

Intermittent use of the equipment sometimes misleads the pilot into believing that because the equipment worked the last time it was used, it should be in readiness. Actually, periods of idleness of electronic apparatus under varying conditions of temperature, humidity, and cleanliness, may as adversely affect the dependability of the equipment as other improper use.

Without the necessary inspection and care the radio installation invariably becomes a repair job. This is an inconvenience that may often be avoided by periodic checking of all the equipment, as well as the installation itself. The servicing of civilian aircraft radio is one of the toughest phases of radio—because neither the equipment, the aircraft, the installation, the pilot's operating procedures, the accessories, nor the maintenance procedures are STANDARDIZED.

Again, compare these points with those of an air-line installation where each installation is alike, almost to the last Elastic Stop Nut, where all pilots and copilots have been thoroughly trained in a standardized operating procedure, where every piece of equipment is overhauled every 30, 60, or 90 days as the case may be, where a specialist inspects the equipment at the origin and terminus of each route, and where even a good share of the ground communications is handled at the other end by air-line personnel and equipment that also have these advantages. Then the difficulties of operating and servicing itinerant aircraft radio become obvious.

Only a minor percentage of so-called itinerant aircraft radio troubles are actually in the radio equipment itself, the majority being in the mechanical installation, the aircraft or its accessories, or in the cockpit. This point may be best illustrated by the following real incident:

A transient pilot stopping at the author's hangar was asked how his radio was working. He explained that the ship had a new radio installation which had considerable ignition noise; however, because it was a new installation he would have it checked (300 miles away) by the installer who guaranteed the work. The pilot asked if a special small landing-gear indicator bulb that was burned out in the aircraft was available and was advised that it was not. It was observed that the pilot, an elderly individual, was somewhat hard of hearing.

Several days later this same pilot's airplane was observed on an approach coming in for a landing—with his landing gear up! After vain attempts to

signal the pilot with arm waving and other methods, the ship plowed onto the runway on its belly, with an extremely perplexed pilot inside.

The warning light for the landing gear was still burned out, the pilot had not heard the gear warning horn, the gear observation Plexiglas was scuffed and dirty, but—most important of all—he had not heard the control tower calling him because *his radio was not working!* He had made an attempt to have the ignition noise taken out of the radio but the man who installed the equipment "had not been available."

It is hoped that with all of the aircraft radio personnel trained by the armed forces, radio service facilities for personal aircraft radio will be more numerous and of a better quality. However, to anyone contemplating radio installation or service facilities, a word of warning should be given to the effect that itinerant aircraft radio problems are for the most part entirely different from those encountered in military aircraft. An itinerant aircraft mechanic has to be a combination radio man, A and E mechanic, pilot, and salesman, and have a keen, analytical mind besides.

The Future for Itinerant Aircraft Radio

Regardless of how fast or how great may be the changes in the equipment and the facilities for civilian aircraft radio, the considerations presented in the foregoing pages of this paper will still hold true.

During a transitional period, such as the next few years will be with the contemplated change-over in the ground station facilities from low frequencies to very high frequencies, a degree of uncertainty may be expected to prevail. The most marked question in the minds of itinerant aircraft radio users, particularly those buying new equipment, is whether to use the old or the new types of equipment. There is assurance from those guiding the airway facilities in this change-over that the currently used frequencies and facilities will be retained until such time as a complete change-over has been effected. This means that in a light aircraft that is limited in weight allowable for radio, it will not be necessary to carry equipment of both types. When new facilities become completely available, the old equipment can be removed and an entirely new radio group installed.

In actual practice, however, it is probable that the inherent advantages of V.H.F. and omni-directional ranges will entice itinerant pilots into using the new equipment as soon as facilities are available in their sphere of flight operations. In some craft then, both old and new systems may be used for a medium length of time, but the advantages to be gained in this change-over will make the cost and inconvenience well worthwhile.

As can be appreciated, the length of time to complete an undertaking such as the full use of V.H.F. is somewhat difficult to predict. The consensus of opinion appears to be that this change-over will require approximately 3 years. It may require 6 months less; it may require a year longer; but whatever time it takes to get the job done, by its assurance of static-free reception and more nearly telephone-like communications, with simpler, lighter weight, V.H.F. radio equipment opens up a bright horizon for the future of itinerant aircraft radio.

Appendix*

With the advent of the postwar period, there have been numerous opinions expressed pro and con on the subject of V.H.F. radio facilities, particularly as concerned with itinerant aircraft. The author, therefore, has added the following analysis of the up-to-the-minute situation and also hazards an opinion as to the probable trend.

It has long been known by everyone who has seriously used aircraft radio that *when the radio was needed most*—such as during storms, in the face of frontal weather activities, on cross-country flights, or simply during characteristic summer static conditions—*it was then that the radio was least satisfactory.* Thus, there can be little question that the basic changeover to V.H.F. with its attendant static-free reception, will be well worth any temporary inconveniences it may cause. Add to this prime gain the advantages of (1) lower transmitter power requirements because of inherently higher signal-to-noise ratio of V.H.F. reception; (2) less interference, particularly from aircraft not in the "local traffic" as is encountered in 3,105 and 6,210 kc. because of equally undesirable "skip" conditions; and (3) eventually, lighter and smaller equipment, especially in the matter of external, "drag-increasing" antennas and there is little doubt about this portion of the program.

It appears, then, that there will be a general transition over to V.H.F. between 108 and 132 megacycles, with itinerant air-borne transmitters probably operating on the 131- to 132-megacycle portion of the spectrum and ground facilities operating radio ranges (omni or two-course types simultaneously, with voice), localizers and airport traffic control (including ground taxiing instructions) operating on channels from 108 to 122 megacycles. It is contemplated that air-borne transmissions and ground reception will be vertically polarized. Ground transmissions and air-borne reception will be horizontally polarized.

Some questions exist as to the types of radio ranges to be installed. Considerable controversy has arisen as to the merits of air-borne controlled, blind landing systems versus ground controlled approach (G.C.A.). These important portions of the program should be watched since they concern all itinerant pilots. Blind landing operations will eventually be a concern of even light-plane pilots in emergencies, if not for a daily fare.

The accelerated aviation radio communication and navigation developments of the war have brought about this degree of confusion; however, when sufficient time has elapsed for consideration to be given to all aspects of this situation, a clear plan will shortly be forthcoming. In the meantime, the C.A.A. personnel who are guiding the program appear to have full realization of the important part private flying will take in the air-borne destiny of our country, and as a minimum we have assurance that the currently used frequencies will be retained in duplicate for at least an overlapping period to allow a reasonably convenient transition to take place.

* Additional material received December 31, 1945.

Changes of Address

To facilitate the prompt receipt of copies of the JOURNAL and REVIEW, members and subscribers are requested to give the Institute 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.

Control Operation of Spratt Wing

GEORGE G. SPRATT*

Consolidated Vultee Aircraft Corporation

History

FLYING ENTHUSIASTS will recall that Lilienthal, previous to 1896, and Percy Pilcher, between 1895 and his death in 1899, made a series of many hundreds of glides using an airplane consisting of a light wing connected to a crude structure to support the operator. The only flight control was the movement of the center of gravity of the operator in respect to the wing. This was accomplished by the movement of his legs, which were dangling freely from the seat.

It is significant that the fatal accident that terminated Pilcher's research was not due to faulty control but to a structural failure. Since flying cannot be limited to one-man gliding only, as the last few years have demonstrated, the combination of pilot, passengers, pay load, engine, fuel, instruments, structure, and protecting enclosure becomes too bulky in size and too heavy in weight to make it practical to move the center of gravity in respect to the wing. The only alternative is moving the wing in such a way as to change the direction of the force vector in respect to the center of gravity—using a movable wing.

The next step in the development of the movable wing airplane was made by Octave Chanute. About 1900, Mr. Chanute built and tested, on the sand dunes along the shore of Lake Michigan, a multiwing glider. The wings were mounted on vertical pivots to swing horizontally so as to bring the center of pressure to coincide with the vertical line passing through the center of gravity. After making about 300 glides, the wings became so warped that further experiments were made with another style of machine, but, to the best of my knowledge, this was the first attempt to control an airplane by moving the wings in respect to the center of gravity of the ship.

In 1908, after many years of aerodynamic study, a glider was built and flown by my father, the late Dr. George Spratt, in which the wing was hinged independently of any framework and controlled by a lever operated by the pilot. Only one crosswise hinge axis was used, parallel with the span of the wing. Lateral and directional control were given by rudder and ailerons. In 1912 another airplane was built incorporating two hinged axes, one for longitudinal and one for directional control. Because of ill health, Dr. Spratt accomplished little more of an outstanding nature between this time and his death in 1934.

It is coincidental that in this same year I built the first controllable-wing airplane to make any great number of successful flights. Development work was carried on with a landplane until 1937. At this time it was thought that progress might be much faster and more privacy afforded with a flying boat, since work could be carried on without the publicity and interference usually found at an airport and without the necessity of flying a highly experimental airplane over terrain that did not afford landing possibilities. On the water, take-off, flying, and landing space is unlimited and, with the exception of isolated fishermen, entirely away from the eyes of the public. These assumptions were confirmed by the good progress made between 1937 and 1943 in developing the controllable wing.

Directional Control

The fuselage of an airplane now being used by Consolidated Vultee Aircraft Corporation to test the Spratt wing is similar in appearance and design to a well-streamlined automobile. The engine is rigidly mounted just behind the center of gravity, and the shaft passes up and back to a propeller at the extreme rear of the car. The landing gear consists of four wheels, the front wheels independently sprung, and the rear wheels interconnected through a torque tube to afford lateral stability on the ground. All four wheels are equipped with hydraulic brakes. The wing is connected to the steering wheel, as are the front wheels. When the steering wheel is turned, the front wheels and wing move simultaneously at the proper ratio, so that the flying and driving feel are similar, if not identical. It looks strange to an amateur observer to see the wing move when the ship is steered on the ground, and equally strange, but considerably less noticeable, that the front wheels assume the ground steering position when the wing steers the ship in flight. The fact that the front wheels steer in the air has no appreciable effect on the flight of the airplane. In the case of my flying boat, however, on take-off, landing, and taxiing, the assistance given by the wing to the water rudder in maneuvering as a boat is extremely effective and essential in taxiing at high speed through congested or small areas.

Directly over the center of gravity of the car of the airplane now being tested a single wing is mounted. This wing is mounted in such a manner that it may be moved about two different axes which control the flight path of the ship. The directional control axis, or the axis about which the wing is moved to control the lateral direction of the airplane in flight, is shown as B–B in Fig. 1. This axis passes upward and rearward through the center of the span. Turning the steering wheel moves the wing about this axis in a manner similar to the way the front wheels of a car are moved about the kingpin.

Fig. 1.

Presented at the Light Aircraft Meeting, I.A.S., Detroit, October 4–5, 1945.

* Nashville Division.

To understand just how this motion of the wing controls the airplane directionally, it is desirable to think of all the lift of the wing being concentrated in a single vector. This assumption may be made because the wing is a single unit, having no ailerons or vanes to change the position or slope of such a vector.

A simple demonstration of the control of this airplane can be made with a model and a piece of string, as shown in Fig. 4. The only requirement for this model is that it be directionally stable; that is, the center of gravity must be ahead of the center of pressure on the sides of the car so that the car will always tend to point in the direction it is going, like a weather vane. The string is attached to the car at the hinge attachment of the wing, and when suspending the ship represents the lift vector. If the other end of the string is held in the hand and the hand moved horizontally in a straight line, the model will go through the air in an attitude similar to flight. Should the hand be moved to one side or the other so as to execute a curve, the string is then sloped and the model will turn in proportion to the slope given the string and will bank in exact proportion to the turn executed. This string actually represents the flight vector, or line of force produced by the wing. When the wing is tilted this vector is also tilted, as was the string in the demonstration.

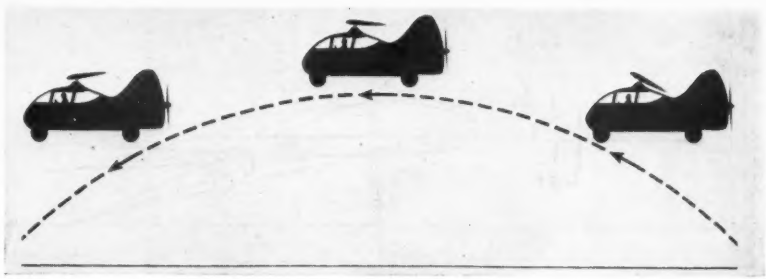


Fig. 2.

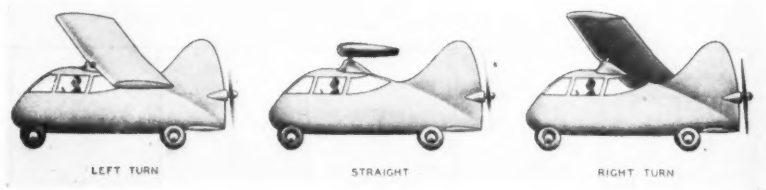


Fig. 3.

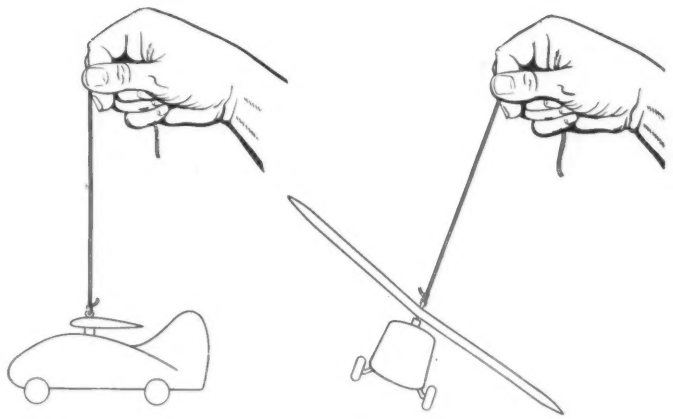


Fig. 4.

Longitudinal Control

The longitudinal control axis, that is, the axis about which the wing is tilted to control the ship up and down, is parallel with the wing span and located just below the lower surface of the wing about 25 per cent of the way back from the leading edge. This axis is shown as line A–A. Moving the control wheel forward rotates the wing about this axis in such a way as to decrease the angle of attack and, consequently, decrease the lift. Moving the control wheel aft increases the angle of attack and, therefore, the lift. The analogy of this control may be shown with the same model and string as used for the directional control analogy. If the model is supported by the string, the tension in the string will exactly equal the weight of the airplane. Should the tension in the string be increased, all the force greater than the weight of the ship will cause an upward acceleration and, conversely, if the pull of gravity is greater than the pull of the string the ship will be accelerated downward. Comparing our single flight vector in the airplane to the string on the model, it is evident that all that is needed for longitudinal control is to change the force of this flight vector without necessarily changing its direction. A look at the simplified vector diagram in Fig. 5 will show how this is done.

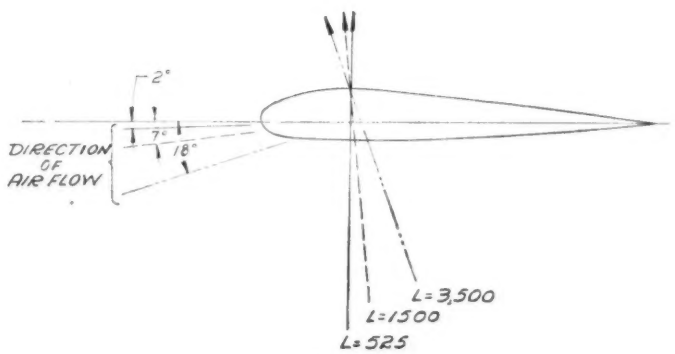


Fig. 5.

The short arrows represent the direction of airflow at a 100-m.p.h. velocity striking the airfoil. The correspondingly indicated vertical arrows represent the amount of lift and its direction relative to the chord. Fig. 6 shows what happens with the controllable wing. Assuming an original constant direction of flight, in changing the angle of attack the wing is moved so that each succeeding lift vector falls substantially in the same plane. When the center of gravity of the airplane is located on this plane, the ship will not nose up or down in response to this control (see Fig. 7), but will simply go up or down, elevator fashion. Bob Townsend, our first test pilot, after starting to fly this airplane, spent one entire

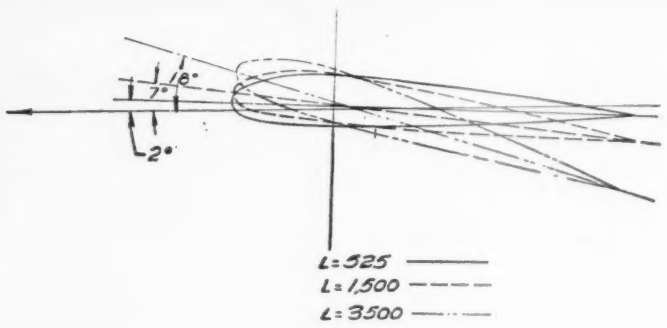
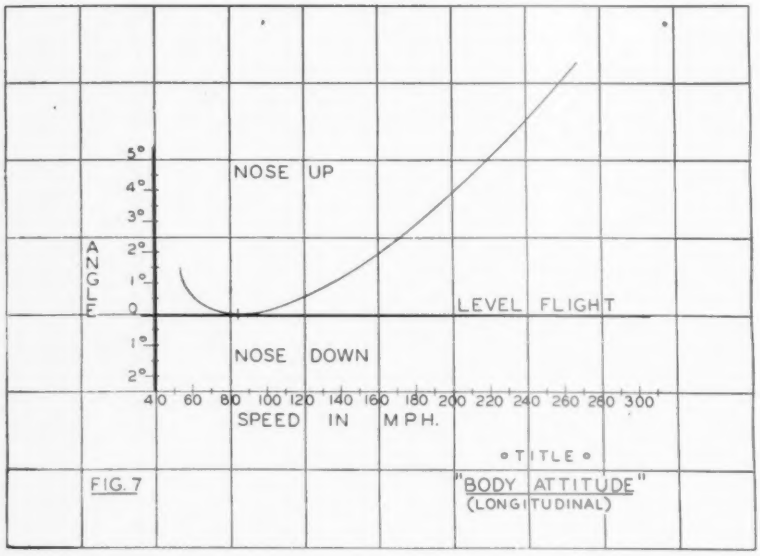


Fig. 6.



morning in a borrowed elevator, just "flying" it up and down. Later on he told us that his experience with the elevator did more good than his previous experience with airplanes.

These last two vector diagrams are slightly oversimplified, but Fig. 8 gives a complete and accurate vector diagram of this wing. The difference between the dotted and solid lines of corresponding angles shows the attitude of the car. In level flight the longitudinal attitude of the car is dependent upon the speed. The car is substantially level throughout the cruising range but tends slightly to nose up with either an increase or decrease in speed.

Control Forces

This vector diagram shows graphically the nature of the control forces to be expected. On this particular diagram the control pivot lies on the 8° vector. Therefore, control force is neutral at 84 m.p.h., corresponding to the 8° angle of attack. Should it be desired to fly the ship at 97 m.p.h., for instance, the line of force is then as shown on the diagram and the shortest distance between this vector and the pivot, multiplied by the weight of the airplane is the torque that must be applied to the wing when flying at this speed. Speeds below 84 m.p.h. tend to tilt the wing down; speeds above 84 m.p.h. tend to tilt it up. The distance from the pivot to the vector increases at a progressively higher rate with increasing speed. *This gives stability of a high order*, as this curve of the speed plotted against the torque shows (see Fig. 9).

Single-Control Airplane

This leads us to interesting speculation on the possibility of a single-control airplane. We have all at some time or other listened to controversies over the relative merits of two- and three-control airplanes. Why not consider a *single*-control ship?

From a broad point of view, the two-control airplane might be considered a single control—assuming the fore-and-aft motion of the stick to be just a speed control. Only the throttle makes the ship continue to go up or down. With a longitudinal control having plenty of stability and speed of response, such as the controllable wing, the function performed by the fore-and-aft motion of the control wheel could well be transferred to a small lever mounted at some convenient point on the instrument panel. The operator would then set this adjustment to the desired position—take-off, cruise, or high speed. To land, it would be necessary only to close the throttle and steer to a desired landing spot. Take-off would be a matter of opening the throttle and steering while taking to the air.

To a person accustomed to driving a car it is most disconcerting to have a

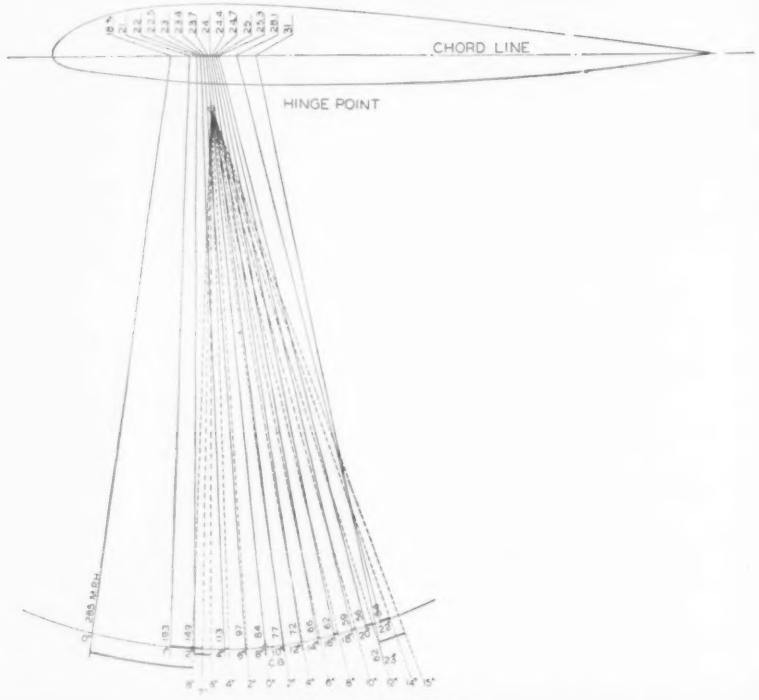


Fig. 8. Vector diagram.

wheel that moves back and forth. I became so convinced of this that in 1942 I built a small flying boat having only a throttle and a fixed steering wheel for control. To test this principle in its simplest form the wing was hinged at a pivot chosen to give a speed slightly above the minimum, as a compromise between take-off and cruising. There was no method used to change the speed. In other words, the ship would take off, fly, and land at only one speed. This ship was undoubtedly the easiest ship to fly that I had ever operated. If it had not been for a slight oversight in design, this ship would still be flying. The oversight was the fact that the center of gravity of the wing was some distance behind the pivot point. In smooth water landings or take-offs this causes no trouble, but, unfortunately, once after taking off the water did not stay smooth and the landing was made under rather rough conditions. The impact of the hull on a large wave, in itself, tends to throw the ship back in the air. This, coupled with a sudden increase in attack of the wing due to the center of gravity being so far behind the pivot, caused the ship to go back up in the air without sufficient flying speed. The next time it came down it did not stop at the surface of the water.

In order to make this scheme practical, it would be necessary in some manner to effectively move the wing pivot fore and aft in relation to the wing. The slope of this moment curve in respect to the zero line is quite constant through the normal operating range, but becomes much steeper at the low speed or landing region, exactly as is needed for *high recovery forces in short recovery times* while landing or taking off.

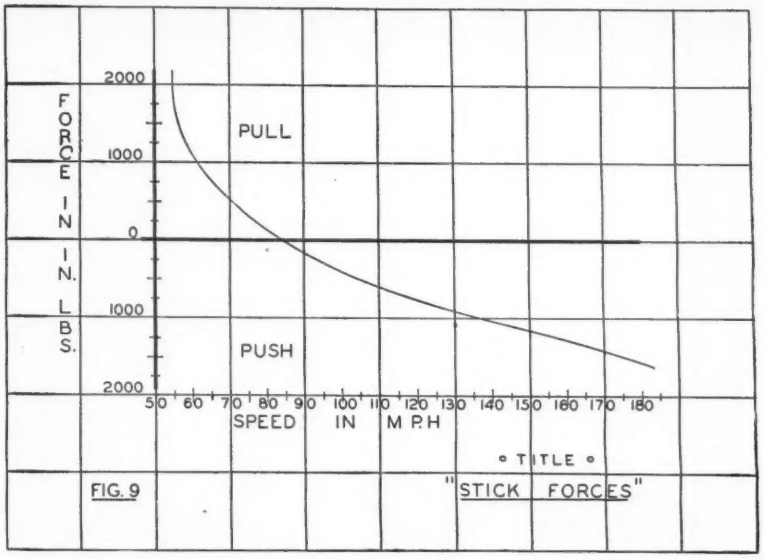


FIG. 9

Flying Boat

This controllable wing, when applied to a flying boat, yields some unexpected and attractive results. It permits the use of an entirely different design of hull from that used on conventional flying boats.

Many thousand years ago the Polynesians were building some pretty good boats—good, except for the fact that they upset too easily. Some pioneer in that day decided to fasten an outrigger to one of these boats and put another small boat or float at the end of this outrigger. This was a solution to the problem and this type of boat was built for a long time. In fact, these people are still building and using this design of craft.

With the progress of science in other parts of the world, someone else found that by properly designing a boat, giving regard to its shape and the position of the center of gravity, one could be built which had inherent stability, not needing an outrigger to keep it from capsizing. This solution to the problem of preventing capsizing changed marine transportation from the small, difficult-to-handle, relatively unseaworthy craft operating among the islands of the South Pacific, to the industry of water transportation as we know it today.

Unfortunately, it might seem to an outsider that designers of flying boats are still generally unaware of this latest advancement in boat design, since they still consistently place the engine high above the water, making it necessary to go back to the Polynesian method of preventing capsizing with outboard floats.

Fortunately, the optimum length of a two-passenger version of this ship closely coincides with the length of the average two-place racing boat operating at speeds comparable to the take-off speed of this ship.

Using the controllable wing it is not necessary to pitch the hull to vary the angle of attack. Neither is there any overhang aft of the stern to support the tail, as no tail is necessary. The hull design is no longer a specialized problem, but the designer may use with little change the lines of the most successful boats now in operation. With the stern used on this flying boat. it is possible to place the engine in the bottom of the hull to give the necessary stability on the water. In fact, the position may be almost identical to that of the boat; the only difference being that, instead of the shaft sloping rearward and downward to a water propeller, it slopes rearward and upward to an air propeller directly over the transom. This propeller location eliminates the possibility of spray entering the propeller disc, regardless of wind or water conditions, at the same time permitting the propeller tips to operate only a few inches above the water level.

National Light Aircraft Meeting

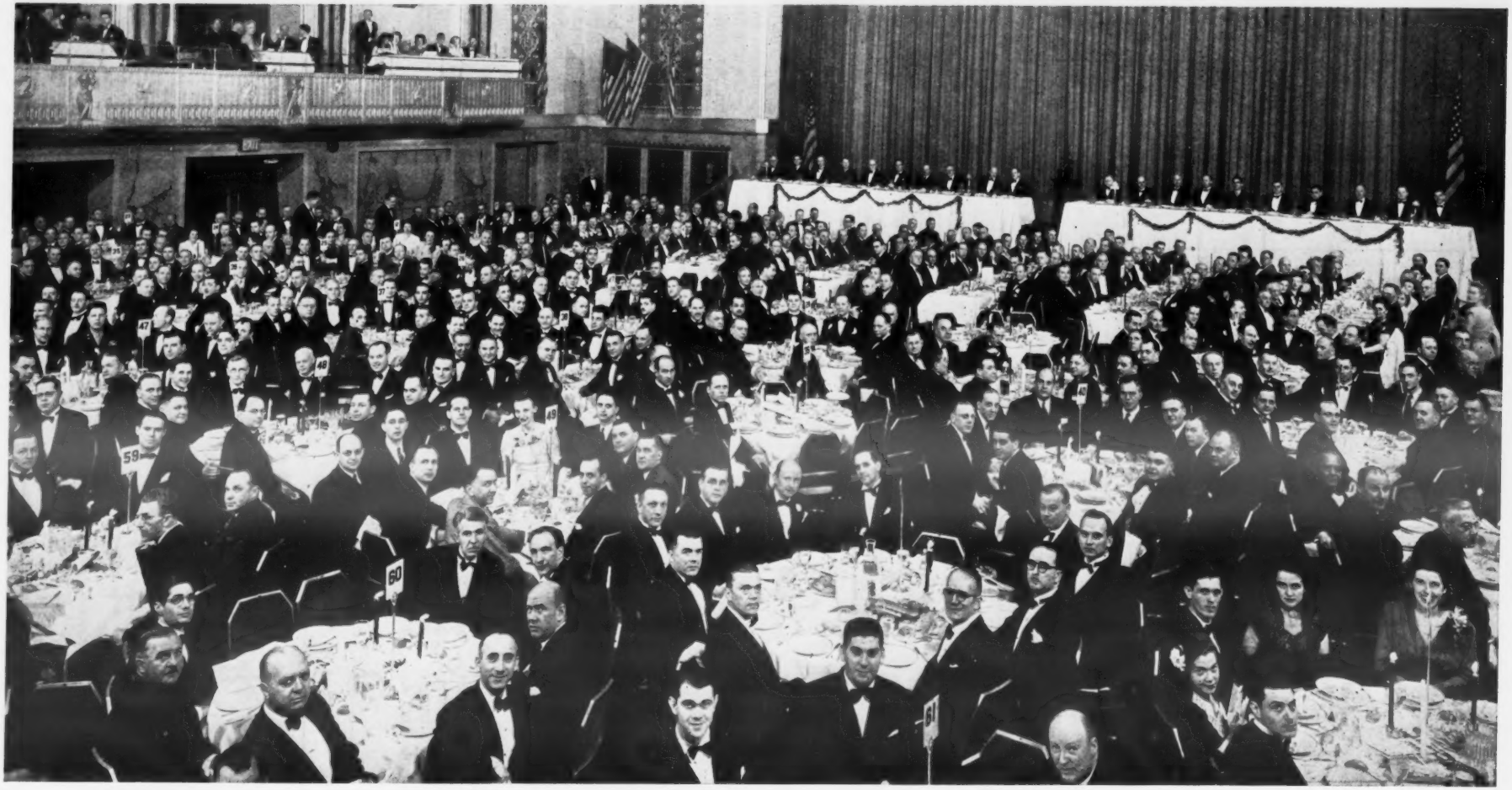
June 13–14, 1946, Rackham Educational Memorial, Detroit, Mich.

The Professional Activities Committee invites participation in the National Light Aircraft Meeting of the Institute.

The Committee will consider for inclusion in the program complete papers, outlines, or summaries of proposed papers, submitted in triplicate. Outlines or summaries should not exceed 1,000 words.

Authors will be notified, in ample time to prepare the complete paper, whether or not their papers can be scheduled for presentation.

Address correspondence to The Professional Activities Committee, Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.



Honors Night Victory Dinner, Institute of the Aeronautical Sciences, Grand Ballroom, Hotel Waldorf-Astoria, New York, January 28, 1946. The photograph shows approximately one-half of those in attendance.

At the speaker's table *(left to right)* are: Lester D. Gardner, President, the Aeronautical Archives; Commodore John C. Adams, Chief Flight Surgeon, Bureau of Medicine and Surgery, Navy Department; Dr. Eugene F. Du Bois, Chairman, Committee on Aviation Medicine, National Research Council; Lieutenant Colonel Harry Wexler, Research Executive, Army Air Forces Weather Service; Dr. F. W. Reichelderfer, Chief, U.S. Weather Bureau; Richard Hutton, Chief Development Engineer, Grumman Aircraft Engineering Corporation; Rear Admiral Luis de Florez, Assistant Chief of the Office of Research and Inventions, Navy Department; T. P. Wright, Civil Aeronautics Administrator, U.S. Department of Commerce; Dr. J. C. Hunsaker, Chairman, National Advisory Committee for Aeronautics; Arthur E. Raymond, President of the Institute; Charles H. Colvin, Past-President of the Institute; Lieutenant General James H. Doolittle, U.S. Army Air Forces; Baron de la Grange, President, Aero Club de France; the Honorable W. A. M. Burden, Assistant Secretary of Commerce, Department of Commerce; Captain Myron Tribus, U.S. Army Air Forces; Dr. Hugh L. Dryden, Assistant Director, National Bureau of Standards; Charles S. Draper, Professor of Aeronautical Engineering in Charge of Instrumentation, Massachusetts Institute of Technology; A. Elliott Merrill, Test Pilot, Boeing Aircraft Company; William Littlewood, Vice-President—Engineering, American Airlines System; Robert T. Lamson, Test Pilot, Boeing Aircraft Company.

Institute of the Aeronautical Sciences Honors Night Victory Dinner

THE HONORS NIGHT VICTORY DINNER of the Institute was held Monday, January 28, 1946, in the Grand Ballroom of the Hotel Waldorf-Astoria in New York. Twelve hundred members and guests attended.

The retiring President of the Institute, Charles H. Colvin, presided. Excerpts from the speeches of presentation and acceptance of awards follow. All salutations and expressions of appreciation have been omitted from this account.

Greeting by the President of the Institute

Mr. Colvin: Distinguished Guests, Ladies and Gentlemen, Members and Friends: The Institute welcomes you to its Victory Dinner. Last year, as many of you will recall, both the Honors Night Dinner and the Annual Meetings were canceled because of the shortage of transportation and the lack of hotel accommodations. Now that there is no longer any difficulty in securing plane or train reservations, or hotel rooms—or am I wrong—we are happy to have you all with us again.

We are especially glad that our Past-President, General Doolittle, has returned to us after making such a distinguished record in the Army Air Forces, and has consented to be our speaker tonight.

We of aeronautics, in common with all other scientists, know no limits of national borders. The language of the formula and the slide rule is international. While the U.N.O. is meeting in London, we have here our own United Nations. I want to introduce to you a few of these guests from overseas.

Among our distinguished guests we have, from Britain, Sir Robert Watson-Watt, Deputy Chairman of the Radio Board of the British Cabinet; Group Captain R. J. Legg, Air Attaché; and Group Captain Christopher Clarkson of the British Air Commission, just out of uniform.

From the Soviet Union we have Lieutenant Colonel A. Y. Galkovsky, Assistant Military Attaché for Air of the U.S.S.R. We had hoped to have with us one of our distinguished Russian members, Lieutenant Colonel Gureev of the Soviet Purchasing Commission, but last-minute pressure of duties kept him in Washington.

From Canada we have Group Captain Homer Smith, Air Attaché.

From the Netherlands we have Mr. J. van der Heyden, Chief Inspector of Civil Aviation.

From the Republic of China we greet Lieutenant Colonel Ko-Tsan Wang, Air Attaché of the Chinese Embassy.

France I have saved for last for reasons that will appear presently.

We are greatly pleased to welcome one of the most outstanding of French aeronautical scientists who has come to New York especially to attend our Annual Meeting. He is a Professor at the University of Lille. When the

Charles H. Colvin.

Germans occupied northern France he escaped to Toulouse, where he has lived in a scientific blackout for the past 5 years. Until he saw them in our library a few days ago, he had not had in his hand a British or American aeronautical publication since 1940. Professor Kampe de Feriet, we are honored to have you with us.

Now I want to introduce to you one of the most distinguished figures in the world of flying, the dean of our foreign guests. He was a pilot in World War I, and was attached to the American Air Service. He was awarded the Distinguished Service Medal by our Government.

He has been the President of the Aero Club of France since 1936.

Baron de la Grange, we should be pleased to hear from you.

Baron de la Grange: It is a great honor to be called upon to address you on behalf of the guests who have been fortunate enough to attend this brilliant meeting.

I thank you, Mr. President, in their name and in mine for your courtesy, which we deeply appreciate. Our feelings are those of immense gratitude.

America has saved our respective countries from serfdom. Our sufferings during the war would have been, indeed, unbearable if it had not been for the hopes which we placed in Russia, in England, and in the United States. We were not deceived in those hopes.

I would have a great deal more to say, but you have asked me, Mr. President, to be brief. I therefore will be as laconic as a Greek orator, and will sum up my speech in a few sentences.

My first remarks concern the past. It was thanks to the help of America that World War I was won. As early as 1917 I came to this country as an officer on Marshal Joffre's mission. Since then I have watched the development of America's aviation industry and of the aeronautical sciences, and their progress in this country has by far exceeded all expectations.

My second remarks concern the present. It was thanks to the valor of American men, but, also, to the efficiency of American industry and to the knowledge of American scientists that World War II was won.

As concerns the future, it is equally true to say that peace can only be maintained if American industry, inspired by American science, retains her leadership. It is, therefore, not going too far to say that the future of mankind is for a large part in the hands of the members of the Institute of the Aeronautical Sciences. We feel sure that they will be worthy of our trust.

Mr. President, Ladies and Gentlemen, in the name of our guests, I wish to express our admiration and gratefulness to General Doolittle, to the heroes of today, and to your great—and to me—very dear country.

Mr. Colvin: Thank you. As most of you know, our Institute has been most fortunate in acquiring a new home into which it moved a week ago. It is a splendid six-story building at the corner of Fifth Avenue and 64th Street. I know you are all most anxious to see it. Those of us who had a hand in its purchase and remodeling are tremendously proud of the new home, and we want every member to explore it from the sixth floor to the subbasement, that he may have a share in our pride.

In spite of restrictions upon much of the technical material which would otherwise have been presented at Institute meetings and printed in Institute publications, the Institute and

Director, National Bureau of Standards; Charles S. Draper, Professor of Aeronautical Engineering in Charge of Instrumentation, Massachusetts Institute of Technology; William Littlewood, Vice-President—Engineering, American Airlines System; Robert T. Lamson, Test Pilot, Boeing Aircraft Company.
Aircraft Company;

its members have, I believe, done a great job during the war period.

This is neither the time nor the place to recount in any detail the services which have been rendered. We do wish to pay tribute to those of our members—and this includes practically all of them—who participated in the war effort, whether with the armed services or in the great achievements of the aircraft industry.

We welcome those who return from war service, and shall increase our efforts to be helpful to those who are reconverting—whether their lives or their plants—to peacetime pursuits.

I am glad that Commander—now Captain—Guggenheim is with us again. After distinguished service in the Navy, he is again available to us for consultation and advice. The estate at Sands Point which his mother so generously gave to the Institute is now being used by the Navy for work which will be of the greatest importance in the postwar period.

We are pleased that Glenn Martin, the great benefactor of the Institute, can be here and know how greatly the members appreciate his princely generosity in setting up in honor of his mother a fund which now amounts to over a half-million dollars.

Shortly, we hope to announce a plan whereby the income from the fund will be used to the great benefit of the aeronautical profession.

Glenn, I hope you will give to your mother our best wishes, and say that the Institute is proud to have been the organization selected to advance aeronautics by the use of the fund that bears her name.

To present the Daniel Guggenheim Medal and Honorary Fellowship in the Institute, I now call on Dr. Hunsaker, first President of the Institute, and a guiding spirit in its formation. A distinguished career as a naval officer, pioneer in aeronautical instruction, now in charge of the department of mechanical and aeronautical engineering at M.I.T., and Chairman of the National Advisory Committee for Aeronautics.

Now Dr. Hunsaker will honor another Past-President of the Institute, Dr. T. P. Wright, Civil Aeronautics Administrator, U.S. Department of Commerce.

Presentation of The Daniel Guggenheim Medal and Honorary Fellowship in the Institute

Dr. J. C. Hunsaker: Tonight it is your privilege to render double honors to a Past-President of the Institute, Dr. T. P. Wright. And it is my privilege, as your agent, to greet a friend and professional associate of nearly thirty years' standing. I like to recall that he is a fellow alumnus of M.I.T., that we both were engineer officers in naval aviation in World War I, and now are both members of the National Advisory Committee for Aeronautics.

Honors have come to Ted Wright as the natural result of his high competence, plus his sincere desire to discharge every responsibility with perseverance and good will. His professional career as an aeronautical engineer has been notable.

The Royal Aeronautical Society of Great Britain made him an Honorary Fellow in 1942. This Society, which celebrates its eightieth birthday this month, has in all that time elected but 17 Honorary Fellows and of these only five were from the United States.

By his recent services in Washington, Dr. Wright made a contribution to the war effort which only time can fully evaluate.

It is certain that he, as much as anyone in the Government service, made our immense aircraft production program function. When the success of this war program was practically assured, the President appointed him Civil Aeronautics Administrator, the key post for the development of postwar civil aviation. He now has the responsibility for bringing to fruition the dreams of those who have looked to the conquest of the air to bring a better way of life.

Tonight as Vice-Chairman of The Daniel Guggenheim Medal Board, I am a substitute for its Chairman, Dr. George W. Lewis, who is ill. This Board is composed of former recipients of the Medal and representatives of the American Society of Mechanical Engineers, the Society of Automotive Engineers, and the Institute of the Aeronautical Sciences.

T. P. Wright *(left)* receives his certificate of Honorary Fellowship in the Institute from Dr. J. C. Hunsaker.

Mr. Guggenheim, that princely benefactor of aviation, endowed this Medal to be awarded for notable achievement in the advancement of aeronautics. This year the Board by unanimous vote awards The Daniel Guggenheim Medal to Dr. Theodore P. Wright for, and I quote the citation: "Outstanding contributions to the development of civil and military aircraft and for notable achievement in assuring the success of our wartime aircraft production program."

I spoke of double honors for Ted Wright tonight. The Guggenheim Medal is the first, and rightly so, as it is perhaps the highest honor that can come to anyone in our profession.

The second honor is one for which I congratulate the Fellows of the Institute for their good judgment in selecting Ted Wright for Honorary Fellow. Only one member may be so chosen in any year. The choice is made by secret ballot of the more than 100 most distinguished aeronautical engineers of the country and three-fourths' approval is necessary. It must be a great satisfaction to receive such recognition from one's professional colleagues.

It is a happy occasion for us all to have double honors come to you, Ted Wright, and an honor for me, too, to be chosen to present to you The Daniel Guggenheim Medal and the certificate of Honorary Fellowship of the Institute.

Acceptance by Dr. Wright

Dr. Theodore P. Wright: As the Bible says, my cup runneth over. I am certainly proud to have been the recipient of these great honors. I am proud and pleased to have so many of my associates and friends present on this occasion. I am glad that the chap with whom I first went up in an airplane, Mr. Rolfs, is here. I am glad the one who soloed me in 1920, Dick DePew, is here. I am glad my first boss in aviation, Jerry Hunsaker—who at that time was the Chief of the Design Section of the Bureau of Con-

struction and Repair (Aviation)—is here. I am glad that my present boss, Bill Burden, is here. And I am particularly glad that my wife is here. I am glad that Harry Guggenheim, who himself and whose father have done so much for aviation and who made possible this award, is present, and, finally, that Lester Gardner, who has done such a great deal in getting this Institute to be a leading organization in aeronautics in the world, is also present at this time.

It is indeed gratifying to have the approbation of one's associates. But I must add a word—all of these things really come through teamwork. Certainly, in the war production effort it was the magnificent cooperation between all of those involved—the aircraft industry, the Government civilian agencies, the Army, and the Navy—that made possible the construction of the terrific armada of planes that made victory possible.

In engineering, likewise, credit can never go to one man. It is always due to the combined teamwork effort of designers, stress-analysis men, aerodynamicists, weight engineers, and all of the other engineering branches that contribute toward the perfection of the airplane. In civil aviation, likewise, it is going to be the job of members of the Civil Aeronautics Board, of us in the Civil Aeronautics Administration, the Aircraft Industries Association and the companies that form that body, the Air Transport Association, the Air Line Pilots Association, and, finally, of the Provisional International Civil Aeronautics Organization that is meeting at Montreal; it is the combined teamwork of all of these groups that will make civil aviation the magnificent agent for the betterment of conditions of mankind in general that it is going to be.

Technical development is only in its infancy in aviation. The aircraft has, we realize, advanced by leaps and bounds in the past several years, and yet we are only on the threshold of further developments that will make these in some respects seem small—with the jet engines, the gas turbine which has made possible this recent flight across the country in four hours and thirteen minutes, with rockets in their various forms which will be developed, with the magnificent developments in electronics which will make air navigation aids such that we can land safely and take off safely in all types of weather—all of these things make the future years, the next ten or fifteen years, magnificent to contemplate in the advances which we will have.

We must never forget the objectives which many of us feel that the airplane is destined to further. It will aid commerce, it will aid transportation, it will aid communication, it will raise standards of living, it will make possible more intimate contacts with our neighbors. And here I quote Bob Ramspeck in a talk he made in Washington a couple of weeks ago when he said, "Get acquainted with your neighbor. You might like him." Finally, it will make possible that permanent peace for which we all have longed so much.

Truly, the world is now a manageable size. May I now quote a brief statement made by General Arnold, that magnificent leader that we had during the World War, who said in a radio address a few days ago: "There can be only one mission for the air forces in the future of aviation. That mission is to preserve the peace. I mean simply that overwhelming air power at the disposal of an international security council is the present way to peace."

Again, I express my appreciation for these great honors. In accepting them, I appreciate and realize entirely the responsibilities which they imply. I intend to discharge them fully in my chosen field of civil aviation. I thank you.

Mr. Colvin: And now for the presentation of the award which was endowed by Dr. Reed I call upon another of the Past-Presidents of the Institute. He is a distinguished scientist whose work is known all over the world. He has recently been made the Assistant Director of the National Bureau of Standards. Dr. Hugh Dryden.

Presentation of The Sylvanus Albert Reed Award

Dr. Hugh L. Dryden: I have the honor of awarding on your behalf The Sylvanus Albert Reed Award for 1945.

This prized award is given annually by the Institute for a "notable contribution to the aeronautical sciences resulting from experimental or theoretical investigations, the beneficial influence of which on the development of practical aeronautics is apparent."

It is my pleasant task to tell you something of Professor Draper, the recipient of this award, and of the work which led to the award.

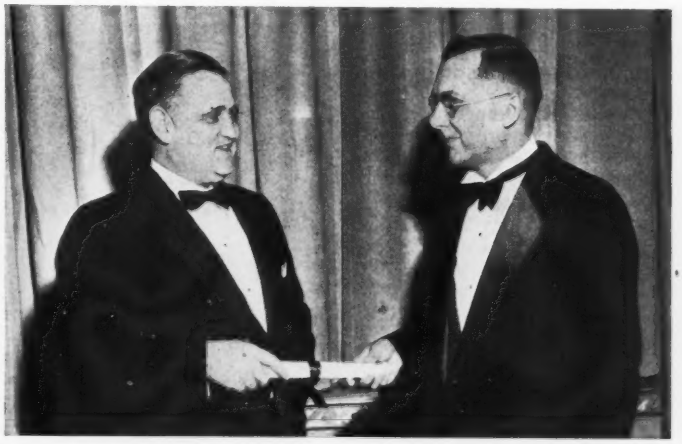
If you will read between the dry lines of the biography of Professor Draper you will find that he received a very broad and fundamental training for his future profession. He was graduated from Stanford University with the degree of B.A. in psychology. I have no doubt he has found occasion to use his knowledge of psychology, both in dealing with the military services and with the other members of our profession.

He then turned his attention to engineering, coming to the Massachusetts Institute of Technology. He received the degree of B.S. in electrochemical engineering in 1926. He turned in 1928 to aeronautical engineering, receiving his M.S. In 1938 he received the Doctor of Science in physics.

Quite seriously, I think you will realize that this broad training in many sciences has much to do with the peculiar genius which he has brought to his chosen field of instrumentation in aeronautics.

His past contributions are well known to many of you in the training of students in aeronautical instruments. We remember also his work in the measurement of vibration, introducing quantitative methods into a field which has been quite difficult.

In trying to tell you why the Fellows elected Professor Draper to this award, I suppose we should use some figure of speech which will express just what is involved, because we cannot describe to you in detail the things which he did. I think we selected him, not so much because of the embodiment of his skill in a particular device, or a particular instrument, but because of something which underlies all the things which he has undertaken. All of us are familiar with the difficulty that engineering students find in analyzing a situation and describing it in terms of mathematical lan-



Dr. Hugh L. Dryden *(right)* presents The Sylvanus Albert Reed Award for 1945 to Charles S. Draper.

guage. Algebra and calculus are always somewhat of a nightmare. I can assure you that while that does take a particular kind of skill or training, the converse is very much more difficult, taking a mathematical equation and clothing it in the flesh and blood of specific apparatus so that it performs as described by the laws which are written down in that equation.

Professor Draper has been able to take bearings, springs, and other components, which have their little, somewhat undesirable, peculiarities and combine them in the design of successful instruments so that these peculiarities do not control the situation and are not brought too forcibly into attention.

This acquaintanceship of Professor Draper with the physical pieces of equipment that go to make a successful instrument and his skill in combining them into an instrument which does follow the laws which one wishes to have the instrument follow; it is for that skill that the Award Committee selected him for this Award.

The specific work which I think we have in mind relates to a contribution to military aeronautics. In this period which is receding so rapidly into the past, which we would all like to forget and turn to other things, the principal object of an airplane was to prevail over the enemy, to shoot the other fellow out of the sky, and to impose your will. For this purpose it is necessary that the airplane have certain teeth. It is also necessary that there be fire-control equipment which sees that our guns find their mark. It is because of the work which Professor Draper has done in cooperation with the Army Laboratory at Wright Field leading to the design of a particular gun sight, and, also, to some extent the work which he has done with the Mark XIV sight for the Navy for shooting down the aircraft of our enemies—because of these specific instruments in which the skill of Professor Draper has recently been embodied, this Award is made.

Professor Draper, as you turn from this work which we now recognize, to other work in a time of peace, I take very great pleasure in presenting to you this certificate and honorarium.

Acceptance by Professor Draper

Prof. Charles S. Draper: It certainly is a very extraordinary situation when fate and an effective group of co-workers put anybody in a position such as I find myself tonight.

For that reason, I have a great appreciation of the honor which has been extended to me, and it is with considerable humility that I receive the award which has been given to me by the Fellows representing the members of the Institute.

Mr. Colvin: The next award was established by Major R. H. Fleet, of whom you will hear more later, in memory of his old friend, Col. Thurman H. Bane, who was the head of the Air Service Engineering Laboratory at Dayton.

The presentation will be made by Secretary W. A. M. Burden. What can I say about him that you do not already know? It was his foresight and generosity that made it possible for the Institute to create an aeronautical library and museum. The library has grown so rapidly that I believe I am safe in saying that its 30,000 volumes now rank it with any other aeronautical library in the world.

We are grateful to him for his interest in the Institute, and proud that he has directed his great talents and experience to the advancement of civil aeronautics.

Presentation of The Thurman H. Bane Award

Hon. W. A. M. Burden: This Award is given to a member of the Army Air Forces Air Technical Service Command, either civilian or commissioned, for outstanding technical achievement.

The recipient this year is Capt. Myron Tribus of the Equipment Laboratory, Air Technical Service Command, Wright Field, whose accomplishment is a very considerable one of reducing the icing hazards of high-speed flying, through research and flight testing, specifically by a joint research project in which both meteorologists and heat-transfer scientists combined to develop means of preventing ice formation by means of heat.

Those of us who are concerned with commercial aviation are especially grateful to any scientist who takes a leading part in attacking the problem of icing. According to Civil Aeronautics Board records, icing has been involved in at least four fatal air-transport accidents in the last three years.

The increased speeds of transport aircraft to the 300–400 mile-per-hour range make the problems of heat deicing very much more difficult, and these difficulties will remain with us at least until transport planes reach the supersonic range where the structure of the aircraft is very appreciably heated by friction.

Captain Tribus and his group, in collaboration with N.A.C.A. experts, have helped show the way to solving these difficulties caused by increased speeds, by analyzing the very fundamentals of the problems and vigorously pushing toward a practical solution. Judging from the Captain's youth and his remarkable scholastic record—he seems to have taken a new scholarship each year during his course at the University of California—I am sure that he will make many more important contributions in this vitally important field.

I hope that before the years bow down his youthful frame he will discover some cheap, reliable method of giving complete ice protection to the small personal airplane.

Acceptance by Captain Tribus

Capt. Myron Tribus: In the presence of so many learned men and of such high rank, it would be indeed presumptuous of a youngster like myself to tell you a lot of new things about airplanes.

It has been a satisfying experience for us at the Equipment Laboratory of the Air Technical Service Command to have worked for the safety of air transportation, and it is a source of deep personal pleasure to note the results of our work will be carried over into peacetime commercial aviation.

We have, you know, only recently come to regard the airplane as a reliable means of transportation, and, yet, inherently, it is the only vehicle which

Presentation of The Thurman H. Bane Award for 1945 to Capt. Myron Tribus *(right)* by The Honorable W. A. M. Burden.

can go from here to there regardless of what is between. In the disputes over who was first into Berlin, I think we have overlooked how many times the airplane had been there first.

That is not to imply that the airplane is today capable of flight under all conditions, but it is certainly within our grasp to make it so.

Making air travel the most reliable means of transportation will not be the work of one person or of a group, or even of one nation. It will be the summation of many men's efforts, for modern research and development is truly a cooperative enterprise.

Our research has been a fitting example of this. We have had hearty assistance from the National Advisory Committee for Aeronautics, from the British, several universities, from the air lines, manufacturers, and many individuals. Now with the war over, we are utilizing the full advantages of all of the foreign data possible.

So I accept this award, and it is with the appreciation and the understanding that I represent not only myself but the many other men who are also striving to aid towards the safety of flight. Thank you.

Mr. Colvin: It is now my great pleasure to introduce to you the Chief of the Weather Bureau.

He has brought the weather service through its transition from a small bureau in the Department of Agriculture to the important scientific agency it now is.

To paraphrase Mark Twain, everybody talks about the weather, but Commander Reichelderfer does something about it. He will now present the Institute's award for meteorology.

Presentation of The Robert M. Losey Award

Comdr. F. W. Reichelderfer: Now that the curtain of military security has been lifted, we can see some of the things that have been accomplished in meteorology as a result of the wartime speed-up of activity and development.

We find a number of noteworthy developments, especially in aeronautical meteorology; for example, radar methods of storm detection, methods of measuring the direction and speed of winds above the clouds, improved tests for determining cloud ceilings more quickly and accurately, weather reconnaissance methods for locating hurricanes and forecasting their movements more definitely, monumental collections of world-wide upper soundings never before available, analytical weather maps for the northern hemisphere for a period of more than forty years, together with a number of important studies contributing to theoretical meteorology, and by no means least, the thousands of young meteorologists trained in the profession during the war.

They represent to the science a larger reservoir of well-trained scientific talent than ever before available to assist in the efforts toward further progress in this field.

I would like to tell you some of these problems in dynamic meteorology that confront us. Meteorology as a science has a huge backlog of unfilled orders.

There have been very noteworthy accomplishments by the Weather Division of the Army Air Forces, by the Aerological Section of the Navy Department, by the University Meteorological Committee, and the people working with it under the direction of Dr. Rossby.

But you are not interested in details, you are interested in results. Through the mutual interest and cooperation of the Institute of the Aeronautical Sciences in this field of aeronautical meteorology, we take this occasion to pay our respect to the memory of a meteorologist who lost his life in the military services of his country, Capt. Robert Moffatt Losey. Through his name we can do honor to one whose primary work in the immediate future will be to plan and carry out some of the needed basic research in meteorology to which I have made reference, especially the application of wartime advances in related fields to the solution of our problems in weather science.

He has been recognized as one of the leaders in meteorological education and research in this country during the last decade. He was one of the early workers in modern methods of weather-map analysis in the Weather Bureau. He has been author of a number of important studies in this field, and his position in the wartime organization of the Army Air Forces testifies to his leadership and professional standing.

Subsequent to his selection for this Award and the printing of your program, he was promoted from Major to Lieutenant Colonel in the Army Air Forces. Since then he has terminated his military service to return to the Weather Bureau in civilian capacity as Head of the Scientific Services Division, where he will take active leadership of the meteorological research program of the Bureau, and where we expect to hear more from him in the future in connection with meteorological progress.

This year's Losey Award goes to Dr. Harry Wexler in recognition of his "outstanding contributions to the science of meteorology as applied to aeronautics," and it is my privilege to present on behalf of the Institute of the Aeronautical Sciences The Robert M. Losey Award to Colonel Wexler.

Acceptance by Lieutenant Colonel Wexler

Lt. Col. Harry Wexler: I haven't addressed as large an audience as this since three years ago when I tried to teach a thousand aviation meteorological cadets dynamic meteorology in Grand Rapids, Mich.

I hope my efforts were successful, and perhaps some day Grand Rapids will be more noted for the quality of meteorologists turned out than for the quality of bedroom furniture.

From the pioneering balloon ascensions of over one hundred fifty years ago to the present-day miracles of high-speed, long-range aircraft, the sciences of aeronautics and meteorology have established an enviable record of mutual aid and stimulation. This collaboration reached a peak during the war when airplanes were used in large numbers to gather meteorological observations over the oceans and enemy territory.

In this way better weather forecasts were prepared for military operations,

Lieutenant Colonel Harry Wexler *(right)* receives The Robert M. Losey Award for 1945 from Dr. F. W. Reichelderfer.

particularly in the air. A vigorous new branch of meteorology came into being—aircraft weather reconnaissance. It is not altogether unlikely that in the near future aeronautical engineers will be asked to design a special airplane for weather reconnaissance.

One of the outstanding developments which I believe will revolutionize meteorological computation will be the application of special high-speed electronic computers to meteorological observation analysis and forecasting.

During the war, electronic engineers constructed for Army Ordnance electric computers of a high-speed type used in computing in a very brief time trajectories for shells and guided missiles.

We are now discussing with these scientists possibilities of building a similar device which would serve as a huge meteorological brain wherein meteorological observations are fed in continuously and out will come the latest state of the atmosphere and its predicted state for the next twenty-four or forty-eight hours.

Other developments have taken place in meteorology, and many of the Army and Navy war-trained meteorologists contributed greatly to these developments. As an illustration of the emergence of this young group, of the thirty-five authors listed in the program of the annual meeting of the American Meteorological Society now being held in New York, seventeen of the authors are members of the armed services—thirteen in the Army and four in the Navy.

I wish to take this opportunity to pay tribute to these men from all walks of life who, receiving a brief intensive training in a new field, rose to their responsibilities and aided greatly in the winning of the war.

Mr. Colvin: The Institute does not confine its honors to aeronautical engineers and physicists. It is, truly, an institute of *the* aeronautical sciences. It recognizes that meteorology and aviation medicine, among other sciences, are as much a part of aeronautics as is aerodynamics.

Our John Jeffries Award honors one of the first Americans to take an interest in aeronautics. In 1786 Dr. John Jeffries financed and made the first crossing by air of the English Channel. He and Benjamin Franklin were the first Americans to arouse a public interest in the scientific possibilities of air travel.

We are honored to have with us tonight a great leader in the war effort in aviation medicine, Dr. Eugene Du Bois. His professional career has been distinguished. He was Physician-in-Chief of the New York Hospital. He is a Captain in the Navy, and was awarded the Navy Cross. He is Chairman of the Committee on Aviation Medicine of the National Research Council. He will present the Award to Commodore Adams.

Presentation of The John Jeffries Award

Dr. Eugene F. Du Bois: His full title is Commodore John C. Adams, Medical Corps, United States Navy, Chief of the Division of Aviation Medicine, President-Elect of the Aero Medical Association of the United States. He is exactly the same person as the man who is known throughout the world of aviation as Cy Adams.

This seems to have been a war in which the nicknames are the ones that go down in history. Commodore Adams, a native of Alabama, entered the Naval Medical Corps in 1917. He completed his course as Flight Surgeon in the Army School of Aviation Medicine in 1923. For the last ten years he has been Chief of the Division of Aviation Medicine.

In this position he has had a profound influence on naval aviation. I would like to speak first about his contributions to research.

During the early days of the national emergency, he served as liaison officer to the National Research Council Committee on Aviation Medicine, of which I happen to be a member. This civilian committee was wise enough to let itself be guided by its liaison officers.

Commodore Adams stimulated civilian research and proved himself one of the keenest critics in a large group of scientists. Later it was my good fortune to serve under Admiral Smith and Commodore Adams, and I was able to see more of the development of research within the Bureau of Medicine and Surgery.

Commodore Adams, with the hearty support of the Surgeon General, was primarily responsible for the development of research units in many naval air stations. Most difficult and probably the most important part of his work was handling the personnel problems during the enormous expansion of the naval air force.

There were never enough flight surgeons to meet demand, but he made the most skillful use of all the personnel available.

A great capacity for friendship and sympathy and tact gave Commodore Adams his opportunity in influencing aviation as a whole. By his wise placement of the right men in the right places, he was able to convince engineers and pilots and commanding officers with the fact that aviation medicine contributed in many different ways to military efficiency.

This was done not only by improvements in equipment, but also in the study of the psychology of aviation, and particularly of the psychology, comfort, and safety of the cockpit.

There was no force more potent than Commodore Adams in forwarding air-sea rescue, flight safety, and the study of pilot flight fatigue as it affected military efficiency.

Someone said—I believe it was an English Jesuit, "It is surprising how much good a man may do in this world if he allows others to take credit for it." Commodore Adams in his good work tried to give all the credit to his associates. Therefore, it is a particular pleasure to show him and the world that he has received recognition at the hands of the Institute of the Aeronautical Sciences.

Commodore Adams, I have the honor to present to you in the name of the Institute "for outstanding contributions to the advancement of aeronautics through medical research" The John Jeffries Award for 1945.

Dr. Eugene F. Du Bois *(left)* presents The John Jeffries Award for 1945 to Commodore John C. Adams.

Acceptance by Commodore Adams

Commodore John C. Adams: To be the recipient of The John Jeffries Award is indeed an honor and distinction. Naturally, I feel complimented and I am proud to have been selected to receive the award for 1945.

During the war, we developed a team in the Medical Corps of the Navy. They were flight surgeons and a group of allied scientists, organized into a Division of Aviation Medicine in the Bureau of Medicine and Surgery. Their contributions are not reflected in an extensive bibliography. Most of their work, and the publications relating thereto, were of a restricted or confidential nature and therefore, the public has had little opportunity to see it. Unfortunately, time will not permit an extensive review of these accomplishments this evening. Nor will the occasion permit a delineation by name of those who contributed so generously to the success of this program.

When I think back to the prewar days when the division consisted of myself and one clerk, and review the vast accomplishments that have come about, you may understand my pride in having been privileged to serve with such a resourceful and progressive group of men. However true this may be, our success could not have been attained except for the loyal and whole-hearted support of the Surgeon General; the solid backing of the Bureau of Aeronautics, which unstintingly supplied us with funds; and, finally, the support of the industry whose help was so essential in converting our ideas and developments into the finished product for the general use of the service.

While I am proud of the accomplishments of our own organization, I gratefully acknowledge the invaluable assistance we received from civilian organizations and institutions. I have in mind particularly, the able and loyal support of Dr. Eugene Du Bois and Dr. Viteles and their respective committees of the National Research Council, and we also extend our gratitude to the many research units of our universities and other institutions who contributed so ably in our common endeavors. Likewise, we enjoyed a free exchange of information from the Army and from our Canadian and British allies which was of great value in the success of our program.

During this war, the casualties for Navy flight surgeons killed in action or in aircraft accidents were at a rate three times greater than for any other class of Navy medical officers. They were a part of the splendid team I have had the honor to head in our Bureau. They were resourceful and enthusiastic.

In accepting The John Jeffries Award this evening, it is with these facts in mind that I gratefully acknowledge their loyalty, support, and the fine contributions they made to their country.

Mr. Colvin: Until the Institute established The Octave Chanute Award at the suggestion of that great engineer and test pilot, Eddie Allen, the men who risked their lives to see whether the engineers have done their jobs well were the forgotten men of aviation.

The engineers did not enjoy having their faults discovered, and the executives did not relish the resulting changes, often involving great expense. The work and reports of the test pilots thus went into the hush-hush rooms of most companies.

Tonight William Littlewood, a great aircraft engineer who has been largely responsible for the development of the largest air-transport company in the country, will honor two flight-test engineers.

Presentation of The Octave Chanute Award

Mr. William Littlewood: For centuries man sought to emulate the bird. No sooner had he accomplished that objective, however, than his continued ambitions strove to fly faster, further, higher, and with greater load than any bird has ever carried. He has accomplished all these things. The attainment of each has required the investigation and determination of hitherto unknown scientific laws. The old familiar laws no longer apply. As speeds have advanced, the books have had to be rewritten.

Increased range and load-carrying capacity which are closely interrelated have necessitated intensive development of engine powers, fuel consumption, structural weight reduction, and the entire exploration into the field of altitude has been met with the complex problems of radical temperature and pressure changes, density changes on structural materials, aircraft performance, power-plant operation, propeller design, fuel and oil behavior, and details too numerous to mention.

The achievement of basic objectives to fly higher and higher has brought inestimable benefits to both military and commercial aviation. It has helped to make tremendous contributions to the successful waging of our aerial warfare and to the ultimate benefits of air transportation in peacetime.

We are tonight honoring two men who throughout the war years collaborated in the investigation and development of high-altitude flight.

The Octave Chanute Award, established in 1939 to honor the memory of one of the great American aviation pioneers and engineers who gave assistance and advice to the Wright Brothers in their early work, is a fitting tribute to these two modern members of the flight-test group of Boeing Aircraft Company whose researches and findings have contributed so much to the development of military and commercial high-altitude flight.

The high-altitude daylight precision bombings of the Boeing B-17, or Flying Fortresses, as well as the application of their findings to the equally spectacular Superfortress B-29 operations are striking testimonials to the value of their work. In part, because of their findings arrived at through great personal courage and devotion, we enter the postwar era able to take full advantage of the benefits of high-altitude flight in commercial aviation.

Mr. Robert T. Lamson graduated from the University of Washington in 1936, and won a scholarship at the Boeing School of Aeronautics, where he engaged in engineering and flight study. In 1939 he was commissioned a Second Lieutenant in the United States Army Air Corps as a fighter pilot. He became

Robert T. Lamson *(right)* and A. Elliott Merrill *(center)* receive The Octave Chanute Award for 1945 from William Littlewood.

a flight instructor of Army Cadets at Cal-Aero Academy in California in 1940. He joined Boeing Aircraft Company in January, 1941, as Engineering Test Pilot.

A. Elliott Merrill received a degree in electrical engineering from the University of Washington in 1926. While at the University he earned his commission in the United States Army Air Corps Reserve. In 1928 he, with a partner, organized and operated the Washington Aircraft and Transport Corporation, continuing in commercial flying enterprises until the outbreak of World War II when he joined the flight-test group at Boeing Aircraft Company.

To these two men, test pilots in the engineering division of Boeing Aircraft Company, the Committee which selects the recipient for the Chanute Award has of this date awarded to them, as co-recipients, the Award for 1945.

When I refer to these two gentlemen as the protégés of Eddie Allen, I think they will feel, as we all should, nothing but pride. I am sure he would be very proud of them.

Acceptance by Mr. Lamson

Mr. Robert T. Lamson: We are both very proud this evening to receive The Octave Chanute Award. We both feel very sincerely this award should be shared with the many pilots and engineers that worked with us at Boeing.

Being a co-recipient with Elliott Merrill, I feel this Award is symbolic of the team spirit so important in accomplishing any research program. Thank you.

Acceptance by Mr. Merrill

Mr. A. Elliott Merrill: My co-recipient has expressed my sentiments. This hasn't been a single-man job that we have been doing in the last few years. It has been teamwork.

I was very happy to hear Mr. Littlewood mention Eddie Allen. The work that we have done in the past few years was successful because of the firm and fine foundation that he laid for us. We in our minds have Eddie with us tonight.

Mr. Colvin: When The Lawrence Sperry Award was endowed by the sister and brothers of that great pioneer of aviation, Lawrence Sperry, we had hoped that they would be with us at these dinners for many years. One of them, Edward Sperry, was lost to us two months ago. We miss his friendly comradeship and are sorry that his distinguished career is over. His generosity in setting up this award will always be a memorial to him. We are happy to welcome here tonight, however, the son of Lawrence Sperry—Lawrence Sperry, Jr.

And now to introduce to you the man who will present the Sperry Award. Those who have attended these dinners know the varied talents of our own Admiral. He can make us laugh by his debunking of unscientific methods. He excites us with the wildest and most fantastic projects. Then he amazes us as we see them come true. He was a pilot away back in 1912, and he has flown ever since. By profession he is an oil technologist—and a very great one—but his avocation has always been aviation. He was awarded the Collier Trophy in 1944 for the greatest contribution to aviation in that year. His Navy career has been phenomenally productive of achievement.

Tonight we are glad to have him with us to present the Institute's Award to one of the younger generation of aeronautical engineers. Rear Adm. Luis de Florez.

Presentation of The Lawrence Sperry Award

Rear Adm. Luis de Florez: It is really a great honor to have been selected to transmit The Lawrence Sperry Award tonight, the Award which was founded to commemorate the genius of a young engineer and pioneer flier, a man who devoted his genius, his enthusiasm, and even his life to the advancement of aeronautics.

Lawrence Sperry, as we knew him, was a great pioneer. He achieved distinction throughout the scientific circles of the world.

As a member and as a representative of naval aviation, I am very grateful in voicing the praise of the carrier-based aircraft which was such a great factor in bringing the victory over Japan.

Those of us who have had the privilege of seeing these aircraft operate off the decks of carriers can never express in words appreciation of their toughness and their competence.

Among the foremost of these aircraft was the famous line of Grumman Hellcats. It is not a simple matter to make carrier-aircraft compete with other types. They must carry the burden of extra weight. They have to be stronger to stand the pounding on the deck, the yank of the arresting gear and the kick of the catapult. Yet these aircraft achieved a remarkable order of performance.

They were the ones that with Task Force 58 went into Truk when Truk was a mystery, when it was a legend. Nobody knew what was in Truk. They didn't know what kind of aircraft were going to come out to meet them. They went in there and they drove the Japs out of the skies. After that we knew what we had to meet. But they went in there and they did a job that is simply extraordinary.

Those same aircraft, manned by these magnificent young fliers, went over the homeland of Japan and scoured the skies, and they drove the Japanese planes out of the sky. Not satisfied with that, they were the ones that destroyed what remained in the smoking ruins of the aircraft installations which the Japs had.

These were carrier-based aircraft with their disadvantages of having a load when they met land-based aircraft—the best that the Japs had—and completely defeated them.

I am grateful to have the opportunity to voice this praise of the carrier-based aircraft—among them the Grumman Cats. I am very happy indeed to be able to present this award to a young man, who went into aviation and who rose in aviation the hard way.

He went to Pratt Institute and worked at night. He started as a me-

Rear Admiral Luis de Florez *(right)* congratulates Richard Hutton, recipient of The Lawrence Sperry Award for 1945.

chanic. He became a draftsman, then a designer, a project engineer, and, finally, chief development engineer. He was the man who had so much to do with the Hellcats and the Wildcats and the whole Cat family that did so much in this war. He is a young man. He is a man who will continue to prove his worth to aeronautics and carry his genius into peacetime pursuits.

It gives me the greatest happiness to present this award to Richard Hutton for his outstanding contributions to the development of carrier-based aircraft.

Acceptance by Mr. Hutton

Mr. Richard Hutton: I wish to thank the members of The Lawrence Sperry Award Committee for selecting me for this high honor.

I find it most gratifying that the Award conferred upon me tonight is for my part in the development of a weapon of naval aviation which was of inestimable value in the past war.

It is no doubt realized that the development of any aircraft is a cooperative undertaking and that a large share of the credit for the results achieved is due those who were associated with me in this development work.

The future of naval aviation is very promising and should provide a field of very interesting development. I hope that as a member of the Grumman organization I shall be able to continue to contribute in this field in a manner which is worthy of the high standards of naval aviation.

Presentation of Fellowships

Mr. Colvin: Now we honor some of our members whose work has been deemed pre-eminent by the group of over one hundred Fellows of the Institute who each year honor the ten members whose work they believe most deserving of recognition.

It is my painful duty to announce, first, that one of the ten, Prof. Harry Bateman of the California Institute of Technology, died while en route to New York to receive his certificate of Fellowship. We have lost a distinguished member. He was a great physicist, and so close to the discovery of relativity that he, instead of Dr. Einstein, might have received credit for that revolutionary concept. [The presentation of Fellowships was made by President Colvin. The list of Fellowships for 1945 is given in this issue in the account of the Annual Meeting of the Institute.]

Now it becomes my privilege to introduce an old friend. Because of the place in the nation's affection to which he has been elevated, it is easy to forget that he is, also, a top-flight aeronautical engineer and scientist. He holds three degrees in engineering—one an Honorary Doctor of Engineering from the Polytechnic Institute of Brooklyn. He took honors at M.I.T. and is, also, a graduate of the University of California.

He is a Fellow of the Institute and has served it outstandingly as its President.

It is as one of us that we welcome him back from the wars. He is now going to talk to us on the work of aeronautical engineers in the war. We may get some compliments, but knowing him as I do, we may expect some criticisms as well. From him the criticisms will be OK.

Address by Lieutenant General Doolittle

Lt. Gen. James H. Doolittle: I am particularly happy to be here tonight at the Victory Dinner of the Institute of the Aeronautical Sciences; for I know of no other group who contributed more to the winning of the War and who deserve more praise for their efforts than the members of this Society.

I am especially happy for the opportunity to publicly acknowledge, in part at least, the great debt of gratitude this Nation owes to the "Forgotten Men" of Aviation—The Aeronautical Engineers. The men who flew the planes and the agencies which built them have gained a portion of their well-deserved recognition but the men who have designed them have, on the whole, gone unheralded. However, it was due to their competence and industry, their skill and ingenuity, that our planes were superior to those of the enemy. This, together with the acknowledged courage and skill of our fliers and the outstanding devotion to duty of the ground crews, gave us air supremacy and ultimate victory.

At this time, I want to make a plea for the continuation of our Wartime Research Organizations and our Wartime rate of development. Our future national security depends upon the aggressive continuation of research and development.

We must have a well-financed National fundamental or basic research agency charged with the carrying out of an extensive program covering all fields of science related directly or indirectly to air power. Each manufacturer must maintain a well-staffed engineering section—self supporting, if possible—and if this is not possible, maintained through government subsidy.

The role of the Aeronautical engineer in the War was threefold:

First: To increase aircraft production from the prewar trickle to the considerable number necessary to meet the requirements of modern War.

Second: To incorporate into today's and tomorrow's planes the modifications and improvements necessitated by changing combat conditions and increased combat knowledge—and—

Third: Through research and development to assure that our future equipment would be of the highest order of excellence—at least equal to and preferably superior to that of the enemy.

Air Power Expansion

Our expansion program really started in 1939. At that time, we had 1,600 military aircraft and were producing them at a rate of about 100 per month. The start was slow.

In January, 1939, the President asked Congress for $300,000,000 to expedite the expansion of our air power. Production was to be increased to 5,500 planes per year. Just prior to this, the Chief of the Air Corps had called the principal aircraft manufacturers together and advised them of the future air plans. They agreed—on their own and with no guarantee—to start an unparalleled expansion program and prepare, as quickly as possible, to double and triple their plant capacity. This patriotic action on the part of the aircraft manufacturers—and later on the part of every other agency connected with aviation—had a very definite effect on shortening the war and saving American lives. The annual goal was quickly pushed up to 10,000 and in early 1940 the Commander in Chief asked for 50,000 planes per year. This unprecedented expansion directive caused consummate consternation in all quarters. Even our progressive and aggressive Air Chief, General Arnold, was staggered by the figure of 50,000. He advised the President that 50,000 airplanes didn't in themselves constitute an air force. They had to be allocated according to type, bomber, fighter; primary, basic and advanced trainers. There must be air and ground crews, airfields, spares, supplies, etc. The figure was reiterated—positively. The initial appropriation was approved and all necessary *additional* items were covered in the *next* appropriation. It was General Arnold's first experience with "political diplomacy" and stood him in good stead for the rest of the War. As a matter of fact the lesson was most helpful to me in building up the Twelfth, Fifteenth and Eighth Air Forces later. I'd ask for more airplanes in order to get more missions off. In a little while I'd have to have more air crews to man the extra airplanes and then more ground crews to maintain them. Then being in balance again, I'd ask for more airplanes. It worked so well that it finally elicited General Kenny's classic remark: "If it weren't for that guy Doolittle we might get some airplanes out here in the Pacific."

Most of the aircraft manufacturers initially felt that the production of 50,-

000 planes per year was impossible of accomplishment. They couldn't make that many and at that time it was believed by most of the aircraft manufacturers that no one without experience in manufacturing aircraft could work to the degree of precision required.

Quantity Production

The seemingly impossible *was* accomplished—and more than accomplished by

A. Expansion of existent facilities.
B. Sub-contracting—and
C. The establishment of new agencies.

There were problems, of course. Non-uniformity of jigs and dies caused some of the early subcontracted parts not to fit. Mass production methods did not lend themselves to limited aircraft production, etc., but how well it did work out is indicated by the fact that 96,369 military airplanes were produced in the United States in 1944. During the peak month—March, 1944—9,117 military planes were produced. This against the lowest month, October, 1939, four years and a half before, when 51 were produced—an increase of 16,860 per cent. As the size of the airplanes also increased, the tonnage increase figures again more than tripled the increase in numbers. Aviation became America's and the World's No. One industry.

This is all very clear in my own memory as my part was to marry the aviation industry and the automotive industry—without benefit of clergy or shotgun.

One of the chief problems interfering with this happy liaison was the fear, on the part of the aircraft industry, that if they set the automotive industry up in the aviation business during the War, they might be a strong competitor after the war was over. In spite of this possibility the aircraft industry pooled their trade secrets and made them generally available; again indicating their patriotic willingness to subordinate all personal interests to the National Welfare.

Manufacturing Coordination

The necessity for coordinating the aviation industries "custom" methods with the automotive industries "mass" method posed a very difficult problem. Airplanes had always been "custom" built. First because there had never before been an order large enough to warrant extensive tooling and second, because of the desirability of being able to incorporate changes and improvements during manufacture. Eventually a compromise was worked out and as a result both industries profited. The aircraft industry learned how to employ applicable mass production methods. The automotive industry became more precise and at the same time more flexible in their tooling. I will never, however, forget the first meeting in Detroit between representatives of these very diverse agencies. Dutch Kindelberger of North American Aviation and Charley Sorensen of the Ford Motor Company, two very positive individuals, did not see eye to eye. As a matter of fact, they weren't even looking through the same keyhole. It appeared that I was in for serious difficulty in the performance of my nuptial duties. As a matter of fact, all agencies cooperated 100 per cent for the national good and I spent one of the happiest, most interesting and most educational years of my life in Detroit.

Keeping Airplanes Up-to-Date

With the manufacture of large numbers of aircraft and the necessary employment of mass production methods, we were faced with the engineers' second problem—keeping the airplanes up to date.

We sent four B-17's to the R.A.F in England for a tactical try-out. They attacked an important military target in Norway. One got back. The Hun fighters had attacked from dead astern. The original B-17's had no tail guns and when tail guns were installed the attacks came from below. Ball turrets were incorporated to meet this tactic. I speak of the B-17 but similar problems arose in connection with all of our aircraft.

Increased knowledge and constantly changing combat conditions made it necessary that extensive modifications be incorporated before the airplanes went into combat. We couldn't ask our boys to risk their lives in anything but the best. Still it is impossible to make the best airplane we know how to build. Before we can complete an airplane, we invariably know how to make it better. Two compromises were effected. First: Major changes were incorporated in the production line only at convenient stated intervals, usually about every six months. Second: Modification centers were established where all essential modifications could be effected after the airplane came from the primary factory and prior to its delivery to the combat theatre. It is odd, but true, that much time was saved by completing a plane in the primary factory, tearing it down in the modification center, and then rebuilding it with the essential changes incorporated rather than in attempting to incorporate these changes in the production line and, thus, upsetting the entire production schedule.

Some of the essential changes and modifications were the result of material failures; others the result of differences in climatic conditions characteristic of a particular theatre; and still others, the result of constantly changing combat conditions. It might be a new enemy defensive or offensive tactic, or it might be an idea that would give us at least a temporary advantage over the enemy. Among these were the necessity for leakproof tanks, added armor and increased armament. The 50-calibre machine gun served us well but when our bombers went beyond the range of their fighter escort and the enemy fighters stayed outside the range of our 50's and lobbed rockets at them (luckily they didn't have proximity fuses), simply increasing the number of 50's did not solve the problem. A harder hitting, higher velocity, flatter trajectory gun and an improved computing sight were required. Both are a must now.

Operational Engineering

Oddly enough, my next job, after leaving Detroit, was Director of Operational Requirements on General Spaatz's staff in Washington. I was to see that our airplanes, in addition to having speed, range, load carrying capacity, ceiling and maneuverability, would do their assigned jobs. I was again a minister or Justice of the Peace. This time I had the job of marrying our technical and our tactical people. It was my assignment to see that the tactical people didn't ask the impossible and that the technical people, within reason, gave them what they wanted.

One of my first jobs was to prepare sixteen B-25's to fly 2,000 miles, each carrying 2,000 pounds of bombs, and then to train the volunteer crews for a special mission. This enabled me to get my hands into the tactical picture for the first time in twenty years and from then on I forsook production and modification and joined the group of "operators"—my erstwhile critics—and then I started criticizing, too.

The first thing I found was that, due to a shortage of 50-calibre ammunition—and an official order that the short supply should not be wasted in practice—none of the guns had been fired since installation in the turrets. Some would not fire at all and the longest burst we got out of any gun before encountering a stoppage was five rounds. Experts had to be called in to correct these troubles. Then we taught our gunners how to keep their guns in condition—and this is not by not shooting them.

To operate the lower turret, we found that the gunner had to take an unnatural position. We were unable to teach him in a month how to use it effectively so that turret was removed—saving that much weight and drag. This points to a very great truth: In time of war you don't have time to teach boys how to use "Unnatural" equipment. All equipment must be designed in as far as possible, so that the user will find it "natural" to employ.

I am a great advocate of "Operational Engineering." Each of the three air forces I later commanded always had an operational engineering section. They were composed of aeronautical engineers, test pilots, and specialists in many fields. Like other aeronautical engineers, they never got the full credit due them but the excellence of our equipment was in no small measure due to the fine work of this small group of men.

If we experienced a mechanical failure, they found the reason for it, corrected it and notified the Air Technical Service Command, who in turn wrote a technical order and had the necessary change incorporated in new planes.

They worked closely with the combat units and gave them immediate service.

In close cooperation with the combat units, they assisted in evolving new tactics and devised means of enabling our aircraft to perform their functions better. In order to get practical experience, they went on many combat missions. Some did not come back. I would like to pay tribute to those heroic engineers who gave their lives to improve our aeronautical equipment. Also I want to publicly express a deep debt of gratitude to the three boys who headed up my operational engineering sections in the Mediterranean and European Theatres of operation, Col. Clare Bunch, Col. Ben Kelsey and Col. Cass Hough, and to all of their subordinates.

They designed special equipment and tested it. At the end of the war, the Eighth Air Force Operational Engineering or Technical Operations Section, as it was later called, was testing a jet-propelled deep penetration bomb for the Royal Navy. The Navy wanted us to deal with the heavily concrete covered submarine pens which conventional bombs wouldn't penetrate and we were also interested in some of the German underground installations. The Operational Engineering Section had also designed and tested a deep penetration needle bomb for use against underground oil storage. With conventional bombs, we could destroy the surface handling equipment, pumps, valves, piping, etc., but couldn't get at the underground storage. The needle bombs were designed to penetrate and puncture these deeply buried fuel tanks.

They designed the safety equipment which enabled us to bomb immediately ahead of our own troops.

Their close contact with combat units, manufacturers' representatives, and the Air Technical Service Command made them invaluable in the field.

Designing for the Future

And now we come to the engineers' third job. Designing for the future.

I will pass over the obvious—such as long-range bombers capable of carrying a bigger load faster, ultra-long-range escort fighters, high-performance interceptor fighters, jet propulsion, electronics, atomic energy, guided air weapons and space ships, all of which are here or just around the corner—in order to deal with some of the less known and more specialized wartime developments.

Gunnery training has always been difficult. With increasing speeds of closure and more rapid angular movement in deflection shooting, a computing sight became essential. Computing sights were first used on flexible guns. When they were put on our fighters, the fighters' effectiveness was increased about 400 per cent.

At first the flexible gunners didn't have confidence in the computing sight. When the going got tough, they went back to their tracers and used a rifle as though it were a shot gun. This induced long bursts. When long bursts were fired, the barrel heated up and expanded to a point where accuracy and hitting power were lost. I had a graphic illustration of this one day over the English Channel. Returning from France in a P-38, I'd been firing short bursts at floating debris for target practice. Three of the four 50's ran out of ammunition, but the fourth gun continued to fire. I held the trigger down to run it but suddenly noticed that although continuing to fire the slugs were not hitting the water out in front of the plane. The bore had expanded to a point where the slugs were just drooling out of the muzzle. The Operational Engineering Section ran a series of tests and we found that the bomber gunners were all firing too long bursts. Just at this time the German Air Force was making its last suicidal stand and it was pretty hard to talk a boy into cooling his guns off when a Hun fighter was coming in on him. They weren't getting enough Huns and the Huns were getting too many of them. To stop the hose spraying tendency, all tracers were removed and the boys had to depend on their computing sights as they couldn't see where they were (or were not) shooting. Tracers, shot laterally from a moving platform, give an entirely erroneous impression as to where the bullets are going. Their gunnery score went up again but, without tracers, the Hun didn't know he was being shot at until he was hit, and consequently bored in more aggressively than he otherwise would have done. To overcome this and still not interfere with accurate shooting, the "Head Light Tracer" was born. The enemy could see the shot coming at him but the chap who fired it couldn't follow its flight.

One of the most important gunnery aides was the frangible bullet. This projectile broke up when it hit a hard surface and did not penetrate. We used some of our fighters, covered with light dural armor plate, to simulate attacks on our bombers. The bomber gunners shot at and hit the attacking fighter—thus getting the best possible kind of gunnery training. The individual armor plates were especially wired so as to cause a signal light to light up every time the attacking plane was hit, thus indicating to the gunner the accuracy of his shooting.

As our air units moved forward it was found that the acquisition and preparation of airfields constituted a major problem. Pierced steel planking had performed outstandingly well in all theatres of operation. However, enough of this material for a runway 150 ft. wide and 5,000 ft. long weighs about 2,000 tons. Shipping and delivery to the forward area, throughout the entire war, constituted our most serious bottleneck; therefore saving in weight was essential. At the end of the war, we were receiving the first pierced aluminum planking which, due to its lightness, was more readily transportable and could, if necessary, economically be transported by air. Furthermore, it could be laid in about one-half the time required for laying the heavier steel matting. The importance of this weight saving can be realized when it is pointed out that in 1944, 1,500,000 tons of steel mattings were shipped overseas. This would surface a four-lane highway from New York to San Francisco.

Weather Forecasting

One of our greatest and most discouraging problems was weather forecasting. Weather was our number one enemy; enemy fighters number two; and enemy flak number three. During Von Runstedt's Ardennes break-through, in late December, 1944, when we flew in spite of weather in order to cooperate with the harassed ground forces, our losses due to weather (crashed on take off and landing and collisions in the air) were greater than the losses due to enemy action.

Air mass analysis, global weather forecasting, long-range forecasting and synoptic climatology have all improved our ability to forecast weather. There is still, however, much to be done and it will be a long time before some of the old-time die-hard pilots give up their simple way of determining tomorrow's weather. This is just to ask a meteorologist for his best guess, then assume it will be the opposite. The only catch in this, they admit, is that occasionally the forecaster guesses right and this exception to the rule completely confuses them.

Aviation Developments

The growing of vegetables in water without soil through the use of chemicals can be considered an aviation development. It is employed where there is no soil or where the soil is polluted. One of the most interesting installations is in operation on Asuncion Island, an air base in the South Atlantic. A two-acre "farm," without soil, produces tomatoes, cucumbers, radishes and lettuce. Even hydroponic plants portable by air have been developed. In these portable plants, vegetables are grown in barrels of chemicals.

Hydroponics is important in itself but it also indicates the necessity for a continually closer tie in between aviation engineering and all branches of scientific development.

The work of the flight surgeon in the war was truly outstanding. The flak suits and flak helmets designed by Brig. Gen. Malcom Grow, now Chief Flight Surgeon for the Army Air Force, saved hundreds of lives in combat. More than 600,000 of these flak suits and helmets were produced for the Army Air Forces.

Physiological studies in fatigue, effect of acceleration, effect of reduced pressure and of insufficient oxygen made by flight surgeons have been answered by the aeronautical engineer through more comfortable seating arrangements, particularly in long-range fighters, G-suits, pressurized cabins and demand oxygen systems.

It was difficult to get fighter pilots to use the G-suits at first but once a pilot had pulled in short, without blacking out, and got an enemy fighter, that individual was sold and he soon sold his unit. The principal argument against the G-suits was bulkiness and discomfort. The air pressure suits were somewhat better than the liquid pressure suits in this respect, but there is a definite need for a comfortable, combination flying and G-suit.

Psychological study has indicated the proper combat tour length. If a combat crew member is kept on combat too long, he is permanently impaired. If he isn't kept on long enough, part of his training and value is wasted. The exact proper length of tour varies with each individual and a mean or par must be arrived at. The group commander and flight surgeon keep an accurate check on each individual crew member. The hardier ones are permitted to do extra missions at their own request and those who show signs of combat fatigue are put on some "important" staff job. Care must be exercised in the latter case not to put a premium on incompetence rather than competence, because this inevitably reduces par.

When I took over the Eighth Air Force in England, losses on deep penetration missions were as high as 6 per cent. As we got more long-range fighters and destroyed the German Air Force then in being, and the bombers destroyed Germany's aircraft productive capacity, our losses went down; finally to 0.6 per cent per sortie. When our losses were high, they were about 75 per cent due to enemy fighter and 25 per cent due to enemy flak. As the enemy fighters were knocked out, our overall losses went down and the ratio changed to 25 per cent fighters and 75 per cent flak. Naturally our tactics were altered to meet this new condition. The principal change was to open out the bomber formations and to break them down into smaller units.

It took a crew about 15 missions before they got really good. They were doing 25 missions, so that left 10 good missions. As the chance of survival went up, I increased missions from 25 to 30 and later from 30 to 35. The first increase meant about a 50 per cent increase in crew value and the second a 100 per cent increase. In spite of the increase in missions, the chance of survival went up substantially. Naturally among my gang, particularly those who had completed a major part of their 25 missions, I was the most detested guy in the United Kingdom.

Aviation psychology was employed in the selection of air crews; also in dealing with them during and after they had completed their combat tours. The Army Air Force does not consider that its obligation is completed when the men come back home. There is the problem of rehabilitation of the physically and mentally wounded. This important work is being carried on splendidly in the various air force convalescent centers. Then there is also the problem of readjustment of all of our air people from wartime to peacetime conditions. The readjustment program implemented by Major Gen. Fred Anderson, who is in charge of air force personnel, and run by Brig. Gen. Leon Johnson, his assistant, is most comprehensive.

The problem of the aeronautical engineer in America was made more difficult by the fact that our planes had to be able to operate any place in the world—in tropic heat and in arctic cold. We were truly the air arsenal of democracy. In 1940 the Army Air Forces got only 886 of the 6,086 planes produced that year. The other 5,200 went to those nations which later became our allies. In spite of the necessity for versatility, our planes were superior, for their purpose, to any in the world. We had the only long-range fighters, we had the only long-range daylight bombers; the only bombers capable of defending themselves against enemy fighters.

All of our present airplanes, as well as the better ones soon to come, are the brain children of our American Aeronautical Engineers. I salute that outstanding group of men and am delighted that the Institute of the Aeronautical Sciences has again honored some of them here tonight.

Gifts to the Institute

Mr. Colvin: We now come to what has always been one of the high spots of each Honors Night Dinner, the account by Lester Gardner of the gifts we have received.

If I were to pick a career for him, other than that of aviation, I believe that I should say he would have made a good hypnotist. Evidently, when he talks to prospective donors, they fall under his spell, for soon we hear of another great gift to the Institute. He is broad in his tastes. Naturally, he likes to receive gifts of money, but he does not limit his talents to any one field. He goes after everything that has any interest to aeronautical science and its history. I have even heard him flattered by being called the greatest pickpocket in aviation.

He founded the Institute in 1932, and has been its administrator ever since.

Response by Major Gardner

Major Lester D. Gardner: You may call me any name you like but I hope that you feel that for the past fourteen years all these oddities have been devoted exclusively to the upbuilding of the Institute.

Mr. Colvin should know that any technique I may have in approaching donors is to enthuse others with some plan or project. All I had to do with getting the large Paul Kollsman endowment was to get Charles steamed up. He found Paul a willing giver. Result, a loan library with 4,000 borrowers.

Mr. Colvin has been a live wire of the Institute ever since. He guarded our funds as Treasurer and, as President, has really been the active head of your society, devoting many months to planning for its activities, particularly in the negotiations for the purchase and reconstruction of our new building. He has also been a generous donor and I know that all you members feel as I do that he has made a great President.

When Captain Harry Guggenheim made the suggestion that his mother give Daniel Guggenheim Park at Sands Point to the Institute, I interested Glenn Martin in the idea. He agreed to cooperate and out of these talks came the greatest gift that any society has ever received from one donor—The Minta Martin Aeronautical Fund. Captain Guggenheim is here tonight and I again thank him for you for the great interest he and his family have taken in the affairs of the Institute.

When I mention my old friend Glenn Martin, my mind goes back through a friendship of thirty years. He agreed to set up a fund of a half-million dollars to be administered by the Institute. The value of the securities in that fund now exceeds that amount and as the endowment is now completed we hope that the income may be used in a way not only to reflect credit to the donor, but that it will be an everlasting tribute to a great lady, Glenn's mother, who has taken such an important part in the successful career of one of America's greatest aircraft constructors. I join with our President in asking him to give her our regards and best wishes.

There are two friends here whom I am sure you will wish to greet. One, a great pilot who has led a charmed life, Captain Eddie Rickenbacker; the other, a Fellow of the Institute, Rear Admiral Land.

I wish I could tell you more about the so-called "technique" that brought such generous gifts from Sherman Fairchild for many purposes; of how Mrs. Bella C. Landauer volunteered without the remotest suggestion on my part to give us aeronautical collections which took her twenty years to gather. She had intended that her son would have this collection, but he, too, wanted to place it where it would give pleasure to others. Mrs. Landauer takes just as much interest in adding to the collections now as when she owned them. This year she gave us a great collection of air-transport labels. She is here tonight with her son, who was a Captain in Marine Corps Aviation and who served in the South Pacific for eighteen months. For you, I thank her again.

It was Bill Burden—I cannot use titles to old friends—who really started the Institute's Archives idea. He is not only one of civil aviation's great proponents, but is an enthusiastic collector of aviation material, particularly

(*Continued on page 37*)

UNITED STATES RUBBER COMPANY
1330 AVENUE OF THE AMERICAS • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

HOW AIRLINE OFFICIALS, ENGINEERS, PILOTS AND HELPED CREATE THIS *"SUPERIOR DESIGN"*

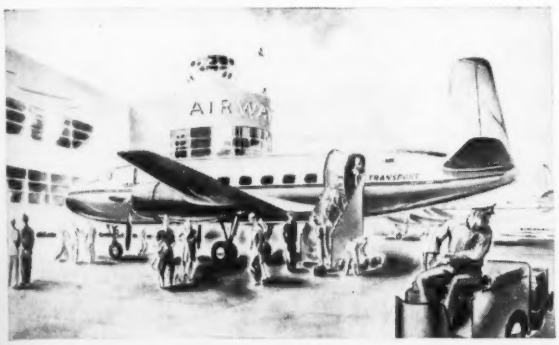
SIX GREAT AIRLINES CHOOSE MARTIN 202

With Braniff, Chicago & Southern, Colonial, Eastern Air Lines, PCA and United Airlines, Inc., already "on the line" to fly the Martin 202—and with others scheduled to follow, this new advanced transport will be plying the airways early in 1947. To achieve superior design, Martin engineers scattered over the major domestic airlines and asked the members of each operational department, "What do you want in an airplane?" The answer is the Martin 202.

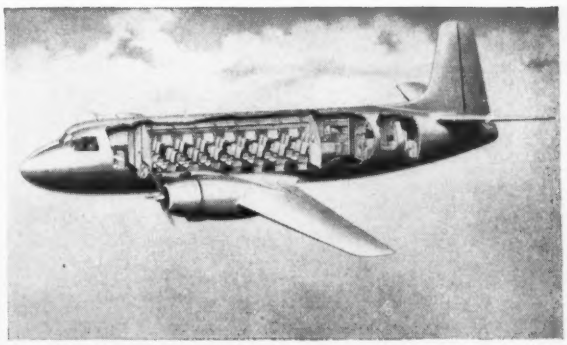
UNITED STATES

HOSTESSES, MAINTENANCE MEN, AIR TRAVELERS

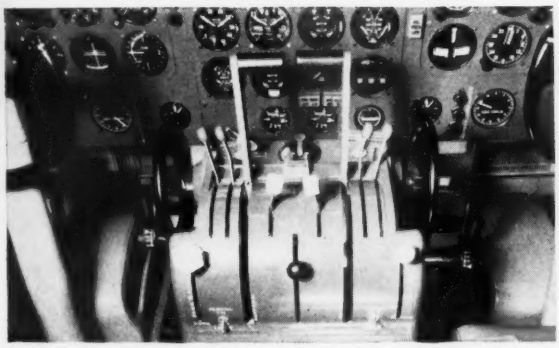
OF THE NEW MARTIN 202...



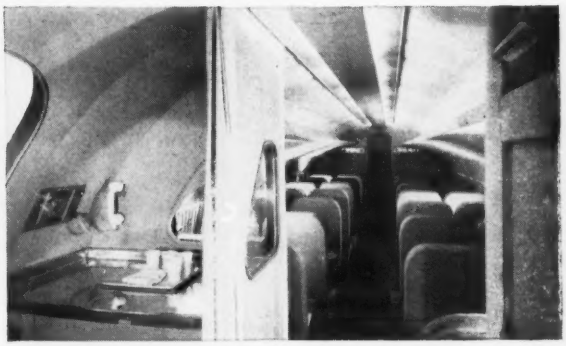
AIRLINE OFFICIALS—The new Martin 202 is a favorite with airline management because it is fast, dependable, and economical.



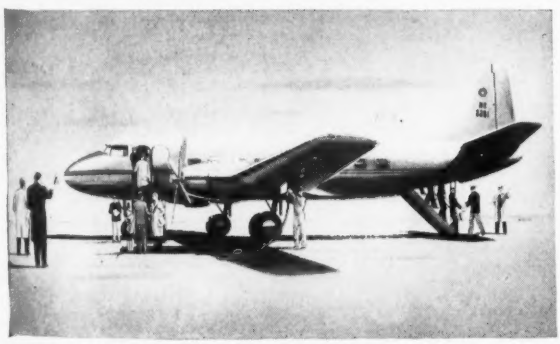
AIRLINE ENGINEERS—They like the compact efficiency of the Martin 202. Its clean design and roomy interior give smooth operation.



PILOTS—Controls and instruments are conveniently grouped at fingertips. No awkward reaching overhead or behind. Clear, complete vision.



HOSTESSES—A separate compartment for the hostess with direct telephone to the pilot's cabin. Everything within easy reach.



MAINTENANCE MEN—Under-wing fueling, accessibility to all apparatus and equipment, simplicity of grouping make the Martin 202 easy to service.

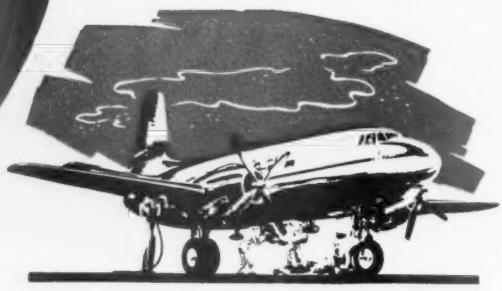
AIR TRAVELERS—The Martin 202 will be a favorite, too, with air travelers. Big, square windows, comfortable seats, air conditioning, plenty of luggage room.

RUBBER COMPANY

1230 AVENUE OF THE AMERICAS • ROCKEFELLER CENTER
NEW YORK 20, N. Y.

SUPERIOR DESIGN

FOR ANY AIRPLANE



U. S. ROYAL AIRPLANE TIRES

In tires as in airplanes, the answer is superior design. Whether for the new Martin 202, for larger or for smaller transports, for giant bombers or private aircraft, there is a U.S. Royal Airplane Tire of superior design for that service. "U. S.", whose pioneering of rayon and nylon cord bodies was the beginning of the truly modern airplane tire, is geared to the needs of peacetime air transport.

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony Program. CBS network, Sunday afternoon, 3:00 to 4:30 E.S.T.

U.S. TIRES

SERVING AMERICAN AVIATION THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

1230 AVENUE OF THE AMERICAS • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

books. He volunteered to loan the Institute his library—the largest privately owned aeronautical library in the world. It will always be a monument to his skill as a collector. It has been in our custody for five years but now that it has a permanent home he has commenced to present parts of it to the Institute. When he heard that Mrs. Landauer had given us her collection of labels he gave us his collection too. Now I am told by experts that we have the finest collection in this country. It is only one of the many collections he has presented. I thank you again and hope that you will make this appreciation an annual event.

Closely allied to this collection is the priceless collection of air-mail covers that John Heinmuller is giving to us. It will put the Institute in the front rank of air-mail collectors. John, accept the thanks of our members.

I see many others here who have added to our Archives. Dr. Kallir, Sherman Fairchild, Dean Hanscom, Colonel Aldrin, and Professor Klemin. Merely mentioning all the names of donors would take more time than we have. I must not forget to mention that Dr. Warner gave us his valuable library of books, also. Thanks to you all.

Now I come to a most amazing story of fund raising. Here, again, it was the imagination and persistence of Major R. H. Fleet who made our greatest hopes come true. When he was president in 1944 he said that he was determined that the aeronautical engineers of this country should have buildings worthy of their profession. He always says "Set your sights high," and he did.

In San Diego, where he lives, he raised from local aircraft firms sufficient funds to build a beautiful building on San Diego's new airport. It will have an auditorium and a library. The major part of this fund was given by Consolidated Vultee Aircraft Corporation. Claude Ryan, Fred Rohr, Ned Price, and others secured handsome gifts from their companies.

Whenever Major Fleet starts to raise a fund he always leads off with a sizeable contribution himself. He has forbidden me to mention the amounts of the many checks he has sent for various purposes but they are large in the aggregate. Even though he is recovering from an operation I know that he is thinking of us tonight because I received a telegram from him which reads:

"Have a good time at the Honors Night Dinner. My regards to all. Sorry I cannot attend. Cheerio."

After success at San Diego he set his sights on Los Angeles. Naturally, he first talked with Donald Douglas, who is one of the Institute's Past-Presidents. Although the project he proposed involved a large expenditure, Mr. Douglas, probably after consulting with Arthur Raymond, agreed to contribute a third of the amount required. This decision stimulated other gifts. Everyone who knows Don knows that he is not only a great engineer himself but wants the aeronautical engineering profession to enjoy every comfort, convenience and facility that generous donors can provide. Fleet then saw Bob Gross and Hall Hibbard of Lockheed, J. H. Kindelberger of North American, and Jack Northrop. He hypnotized them with his proposal. Consolidated Vultee also made a contribution to the fund. When they agreed to make liberal contributions many other companies followed their lead. As a result, the Institute now owns property on the Miracle Mile on Beverly Boulevard and plans are made to build this year.

To all of our great donors on the West Coast I express the great appreciation of the Institute.

Until he had completed his program on the Pacific Coast, Major Fleet did not come to New York. He waited until he had all the checks actually in his pocket. I am not mentioning amounts; those are details that appear in our financial statements. I am more interested in giving you background material and expressing our appreciation publicly.

Fleet's plans here fired the enthusiasm of Roy Grumman and after only a short conversation Roy agreed that his company would make the first contribution. Fleet wanted to build a ten-story building with every facility for a national headquarters. This could not have been done for several years so it was decided that we would remodel an existing building. F. H. Magin of the Square D Company, the General Electric Company, and Earl Osborn of Edo Aircraft saw the merit of the plan and made generous gifts immediately. Then Curtiss-Wright, Bendix, United Aircraft, and Glenn Martin and the Sperry Company made substantial gifts. Republic Aviation, Bell Aircraft, Fairchild Aviation, Beech Aircraft, and twenty other companies made further contributions. All the names of the donors will appear on a plaque that is to be placed in the building. But the endowment for the building has only started. We need at least two hundred thousand dollars more to provide for the future and I know that many of you here will wish to contribute to this fund when you see the building.

That concludes my gift report for 1945. It may have seemed long but the gifts were many and it is the unique policy of the Institute to express appreciation publicly at these Honors Night Dinners rather than to tuck them away in some financial statement.

Oh! I almost forgot. I wish to express our appreciation to Uncle Sam who by his tax laws lends encouragement to donors in a very practical way. Again, thanks, Donors.

Mr. Colvin: Thank you for leaving to me the honor of making one gift announcement, and that is the gift which the Institute has received from the Government of the Union of Soviet Socialist Republics. They have sent to us a complete set of the insignia of the Soviet Air Force. We shall be very proud to display in our museum this evidence of their friendship.

Induction of Arthur E. Raymond as President

Mr. Colvin: Now I come to the final act with strangely mixed emotions; pride in the year's accomplishments of the Institute, regret that many needful things have not been done, confidence that the new year will be one of great progress, and satisfaction that our Council has selected such an able leader as your new President. Most of you know Arthur Raymond. He is one of the industry's great engineering executives. A graduate of Harvard, he took his Master's degree at M.I.T. in aeronautics. He joined the Douglas Aircraft Company in 1925, and has steadily advanced. For the past 10 years he has been in charge of all the engineering of this great company which has designed and manufactured outstanding airplanes for war and commercial purposes.

Arthur E. Raymond.

Mr. Raymond is a Fellow of the Institute. He was Chairman of the Los Angeles Section during 1945, and with Major Fleet has been instrumental in giving impetus to the Los Angeles building. He brings to the Institute long experience as an engineer and executive, and, in addition, a devotion to

(*Continued on page 135*)

An Appreciation

TO CORPORATE MEMBERS OF THE INSTITUTE OF THE AERONAUTICAL SCIENCES

Listed below are the leading aeronautical and industrial companies that make possible the publication of the *Journal of the Aeronautical Sciences*.

They enable the Institute to publish scientific and technical papers in the *Journal* and to devote its pages exclusively to editorial material.

Dues from individual members which would normally be used to publish this scientific and engineering monthly are thus released for additional services to the profession and industry.

The *Aeronautical Engineering Review* and the *Aeronautical Engineering Catalog*, together with the *Journal*, provide a comprehensive technical information service for the benefit of the aircraft and related industries.

ACADEMY OF AERONAUTICS
AERO INSURANCE UNDERWRITERS
AEROJET ENGINEERING CORPORATION
AERONAUTICAL PRODUCTS, INC.
AEROQUIP CORPORATION
AGAWAM AIRCRAFT PRODUCTS, INC.
AIRCHOX COMPANY DIVISION, JOYCE AVIATION, INC.
AIRCRAFT RADIO CORPORATION
AIREON MANUFACTURING CORPORATION
AIRESEARCH MANUFACTURING COMPANY
  AIRESEARCH MANUFACTURING COMPANY OF ARIZONA, INC.
AIREX MANUFACTURING COMPANY, INC.
ALLIS-CHALMERS MANUFACTURING COMPANY
ALLISON DIVISION, GENERAL MOTORS CORPORATION
ALUMINUM COMPANY OF AMERICA
AMERICAN AIRLINES SYSTEM
  AMERICAN OVERSEAS AIRLINES, INC.
AMERICAN BOSCH CORPORATION
AMERICAN PHENOLIC CORPORATION
ASSOCIATED AVIATION UNDERWRITERS
ASSOCIATED FOUNDRIES & MANUFACTURERS, INC.
ATLAS SUPPLY COMPANY
BAKER STEEL & TUBE COMPANY
BEECH AIRCRAFT CORPORATION
BELL AIRCRAFT CORPORATION
BENDIX AVIATION CORPORATION
  BENDIX PRODUCTS DIVISION
  BENDIX RADIO CORPORATION
  ECLIPSE-PIONEER DIVISION
  EXPORT DIVISION
  FRIEZ INSTRUMENT DIVISION
  PACIFIC DIVISION
  SCINTILLA MAGNETO COMPANY
THE BG CORPORATION
BOEING AIRCRAFT COMPANY
BOEING SCHOOL OF AERONAUTICS
BREEZE CORPORATIONS, INC.
  ESSEX TOOL & DIE COMPANY
  FEDERAL LABORATORIES, INC.
CAL-AERO TECHNICAL INSTITUTE, A DIVISION OF GRAND CENTRAL AIRPORT COMPANY
CARRIER CORPORATION
CESSNA AIRCRAFT COMPANY
CHANDLER-EVANS CORPORATION
CHASE NATIONAL BANK OF THE CITY OF NEW YORK
THE CLEVELAND GRAPHITE BRONZE COMPANY
THE CLEVELAND PNEUMATIC TOOL COMPANY
  AUTOMOTIVE-AIRCRAFT DIVISION
CLIFFORD MANUFACTURING COMPANY
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
  NASHVILLE DIVISION
  STINSON AIRCRAFT DIVISION
CONTINENTAL MOTORS CORPORATION
COX AND STEVENS AIRCRAFT CORPORATION
CULVER AIRCRAFT CORPORATION
CURTISS-WRIGHT CORPORATION
  AIRPLANE DIVISION
  DEVELOPMENT DIVISION
  PROPELLER DIVISION
  WRIGHT AERONAUTICAL CORPORATION
DOAK AIRCRAFT COMPANY, INC.
DOUGLAS AIRCRAFT COMPANY, INC.
  EL SEGUNDO PLANT
  LONG BEACH PLANT
THE DOW CHEMICAL COMPANY
DZUS FASTENER COMPANY, INC.
EASTERN AIR LINES, INC.
EATON MANUFACTURING COMPANY
THOMAS A. EDISON COMPANY, INC., INSTRUMENT DIVISION
EDO AIRCRAFT CORPORATION
THE ELECTRIC AUTO-LITE COMPANY
ELECTROL INCORPORATED
ENGINEERING AND RESEARCH CORPORATION
ETHYL CORPORATION
THE FAFNIR BEARING COMPANY
FAIRCHILD CAMERA & INSTRUMENT CORPORATION
  FAIRCHILD AERIAL SURVEYS, INC.
FAIRCHILD ENGINE AND AIRPLANE CORPORATION
  DURAMOLD DIVISION
  FAIRCHILD AIRCRAFT DIVISION
  RANGER AIRCRAFT ENGINES DIVISION
FEDERAL TELEPHONE AND RADIO CORPORATION
FIRESTONE AIRCRAFT COMPANY
FLEETWINGS DIVISION, KAISER CARGO, INC.
FLETCHER AVIATION CORPORATION
G & A AIRCRAFT, INC.
GENERAL AIRCRAFT EQUIPMENT, INC.
GENERAL AVIATION EQUIPMENT COMPANY, INC.
GENERAL ELECTRIC COMPANY
GENERAL INSTRUMENT CORPORATION
GENERAL MOTORS CORPORATION
  AC SPARK PLUG DIVISION
  AEROPRODUCTS DIVISION
  BUICK MOTOR DIVISION
  CADILLAC MOTOR CAR DIVISION
  CHEVROLET MOTOR DIVISION
  DELCO PRODUCTS DIVISION
  DELCO-REMY DIVISION
  EASTERN AIRCRAFT DIVISION
  FISHER BODY DIVISION
  FRIGIDAIRE DIVISION
  HARRISON RADIATOR DIVISION
  RESEARCH LABORATORIES DIVISION
  ROCHESTER PRODUCTS DIVISION
THE GENERAL TIRE & RUBBER COMPANY
THE B. F. GOODRICH COMPANY
THE GOODYEAR TIRE & RUBBER COMPANY
THE GRAY MANUFACTURING COMPANY
GRUMMAN AIRCRAFT ENGINEERING CORPORATION
GUIBERSON DIESEL ENGINE COMPANY
W. & L. E. GURLEY
HANNA ENGINEERING WORKS
HASKELITE MANUFACTURING CORPORATION
HAWAIIAN AIRLINES LIMITED
HAYES INDUSTRIES, INC.
THE HILLIARD CORPORATION
THE INTERNATIONAL NICKEL COMPANY
JACK & HEINTZ, INC.
JACOBS AIRCRAFT ENGINE COMPANY
JOHNS-MANVILLE SALES CORPORATION
CASEY JONES SCHOOL OF AERONAUTICS, INC.
KELLETT AIRCRAFT CORPORATION
KENYON INSTRUMENT COMPANY, INC.
WALTER KIDDE & COMPANY, INC.
KOLLSMAN INSTRUMENT DIVISION, SQUARE D COMPANY
LAISTER-KAUFFMANN AIRCRAFT CORPORATION
LANGLEY CORPORATION
LAVELLE AIRCRAFT CORPORATION
LEAR INCORPORATED
LIBERTY AIRCRAFT PRODUCTS CORPORATION
LIGHTS, INCORPORATED
LINK AVIATION DEVICES, INC.
THE LIQUIDOMETER CORPORATION
LOCKHEED AIRCRAFT CORPORATION
LONGINES-WITTNAUER WATCH COMPANY, INC.
MAGNAFLUX CORPORATION
THE MARQUETTE METAL PRODUCTS COMPANY
THE GLENN L. MARTIN COMPANY
THE W. L. MAXSON CORPORATION
WARREN McARTHUR CORPORATION
McDONNELL AIRCRAFT CORPORATION
MENASCO MANUFACTURING COMPANY
MICROMATIC HONE CORPORATION
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
MOORE DROP FORGING COMPANY
NATIONAL CITY BANK OF NEW YORK
NATIONAL CREDIT OFFICE, INC.
THE NATIONAL SCREW & MANUFACTURING COMPANY
THE NEW YORK AIR BRAKE COMPANY
NOORDUYN AVIATION LIMITED
NORMA-HOFFMANN BEARINGS CORPORATION
NORTH AMERICAN AVIATION, INC.
  NORTH AMERICAN AVIATION, INC., OF TEXAS
NORTHROP AIRCRAFT, INC.
NORTHWEST AIRLINES, INC.
OTTO AVIATION CORPORATION
OWENS-CORNING FIBERGLAS CORPORATION
PAN AMERICAN WORLD AIRWAYS SYSTEM
THE PARKER APPLIANCE COMPANY
PENNSYLVANIA-CENTRAL AIRLINES CORPORATION
PESCO PRODUCTS COMPANY DIVISION, BORG-WARNER CORPORATION
PHILLIPS PETROLEUM COMPANY
PIONEER PARACHUTE COMPANY, INC.
THE PURE OIL COMPANY
REPUBLIC AVIATION CORPORATION
J. P. RIDDLE COMPANY
A. V. ROE CANADA LIMITED
JOHN A. ROEBLING'S SONS COMPANY
ROHR AIRCRAFT CORPORATION
ROMEC PUMP COMPANY
ROOSEVELT FIELD, INC.
THE RYAN AERONAUTICAL COMPANY
SCIAKY BROTHERS
SCOTT AVIATION CORPORATION
SHELL OIL COMPANY, INC.
SIMMONDS AEROCESSORIES, INC.
SKYDYNE, INC.
SOCONY-VACUUM OIL COMPANY
SOLAR AIRCRAFT COMPANY
SPERRY GYROSCOPE COMPANY, INC.
SQUARE D COMPANY
STANDARD OIL COMPANY OF CALIFORNIA
STANDARD OIL COMPANY (INDIANA)
STANDARD OIL COMPANY OF NEW JERSEY
SWEDLOW AEROPLASTICS CORPORATION
TELEFLEX LIMITED
THE TEXAS COMPANY
THOMPSON PRODUCTS, INC.
TINNERMAN PRODUCTS, INC.
TITEFLEX, INC.
TRANSCONTINENTAL & WESTERN AIR, INC.
TRIPLETT & BARTON, INC.
UNION CARBIDE AND CARBON CORPORATION
  BAKELITE CORPORATION
  HAYNES STELLITE COMPANY
  LINDE AIR PRODUCTS COMPANY
  NATIONAL CARBON COMPANY
UNITED AIRCRAFT CORPORATION
  CHANCE VOUGHT AIRCRAFT DIVISION
  HAMILTON STANDARD PROPELLERS DIVISION
  PRATT & WHITNEY AIRCRAFT DIVISION
  PRATT & WHITNEY AIRCRAFT CORPORATION OF MISSOURI
  SIKORSKY AIRCRAFT DIVISION
UNITED AIR LINES, INC.
UNITED STATES AVIATION UNDERWRITERS, INC.
UNITED STATES RUBBER COMPANY
  DOMINION RUBBER COMPANY, LTD.
THE VARIETY AIRCRAFT CORPORATION
VICKERS, INC.
VICTOR ADDING MACHINE COMPANY
VIDAL CORPORATION
THE WACO AIRCRAFT COMPANY
WARNER AIRCRAFT CORPORATION
THE WEATHERHEAD COMPANY
WESTERN AIR LINES, INC.
WESTINGHOUSE ELECTRIC CORPORATION
WESTON ELECTRICAL INSTRUMENT CORPORATION
WYMAN-GORDON COMPANY
YOUNG RADIATOR COMPANY

Institute of the Aeronautical Sciences Fourteenth Annual Meeting

THE FOURTEENTH ANNUAL MEETING of members of the Institute of the Aeronautical Sciences, Inc., was held in New York on the last Wednesday of January, as required by the Constitution and By-Laws, in the Pupin Physics Laboratories, Columbia University, 120th Street and Broadway, at 5:00 p.m. on January 30, 1946. Charles H. Colvin presided.

Prof. F. K. Teichmann, Teller, reported that he had received and counted 539 valid proxies for voting at the Annual Meeting—a quorum of the voting membership.

Dr. Clark B. Millikan, on behalf of the Nominating Committee, placed in nomination the following members for election to vacancies on the Council: Preston R. Bassett, Charles H. Colvin, Leroy R. Grumman, C. S. Jones, J. H. Kindelberger, Otto E. Kirchner, John C. Leslie, Arthur E. Raymond, and Burdette S. Wright, for a term of one year each; Earl D. Osborn for a term of two years; E. E. Aldrin, Lawrence D. Bell, W. A. M. Burden, James H. Doolittle, and Jerome Lederer, for terms of three years each. On motion duly made, seconded and carried, they were unanimously elected. The following were nominated and elected in like manner to serve on the Nominating Committee for 1946: Charles H. Colvin, Donald W. Douglas, Hugh L. Dryden, R. H. Fleet, William Littlewood, Alfred Marchev, Clark B. Millikan, W. A. Patterson.

The Annual Reports of the President, Treasurer, Administrative Committee, and President of the Aeronautical Archives were read and approved. (See the following pages for complete reports.)

The Secretary presented a list of honors conferred by the Institute in 1945 as follows:

The Sylvanus Albert Reed Award to Charles S. Draper.

The Thurman H. Bane Award to Capt. Myron Tribus.

The Robert M. Losey Award to Lt. Col. Harry Wexler.

The John Jeffries Award to Commodore John C. Adams.

The Octave Chanute Award to Robert T. Lamson and A. Elliott Merrill.

The Lawrence Sperry Award to Richard Hutton.

Honorary Fellowship in the Institute to Theodore P. Wright.

(Citations for the above awards are published in the account of the Honors Night Victory Dinner in this issue of the REVIEW.)

Fellowship in the Institute to Harry G. Armstrong, Colonel, U.S. Army Air Forces; Harry Bateman, Professor of Aeronautical Mathematics and Theoretical Physics, California Institute of Technology (deceased); William Bollay, Lt. Comdr., Bureau of Aeronautics, Navy Department; Kenneth Campbell, Senior Project Engineer, Wright Aeronautical Corporation, Division of Curtiss-Wright Corporation; Franklin R. Colibohm, Assistant to Vice-President of Engineering, Douglas Aircraft Company, Inc.; Harold R. Harris, Vice-President and General Manager, American Overseas Airlines; John C. Leslie, Vice-President of Transatlantic Operations, Pan American Airways System; John R. Markham, Associate Professor of Aeronautical Engineering, Massachusetts Institute of Technology; Sanford A. Moss, Consulting Engineer, General Electric Company; and Frank L. Wattendorf, Head Aeronautical Engineer, U.S. Army Air Forces.

Honorary Membership in the Institute for the year 1945 was conferred by the Council upon Dr. E. U. Condon, Director of the National Bureau of Standards; Brig. Gen. L. C. Craigie, Chief, Engineering Division, Air Technical Service Command; Vice Adm. Arthur W. Radford, Deputy Chief of Naval Operations for Air; Rear Adm. H. B. Sallada, Chief, Bureau of Aeronautics, Navy Department; Rear Adm. L. C. Stevens, Director of Engineering, Bureau of Aeronautics, Navy Department; Lt. Gen. Nathan F. Twining, Commanding General, Air Technical Service Command.

On motion duly made, seconded and carried, the following resolution was passed.

Resolved, That the Institute express to Acting President Frank D. Fackenthal and Dean George B. Pegram of Columbia University the appreciation of its members for the cooperation and gracious hospitality extended to the Institute during its Annual Meeting.

The Secretary announced that the Council had elected the following officers of the Institute for 1946:

President—Arthur E. Raymond.
Vice-Presidents—
Preston R. Bassett.
J. H. Kindelberger.
John C. Leslie.
Burdette S. Wright.
Executive Vice-President—Bennett H. Horchler.
Treasurer—C. S. Jones.
Chairman of the Council—Lester D. Gardner.
Assistant to the President—George R. Forman.
Secretary—Robert R. Dexter.
Controller—Joseph J. Maitan.

ROBERT R. DEXTER

The President's Annual Report, 1945

Nineteen forty-five, which saw the final defeat of both Germany and Japan, the first use of atomic energy, and the beginnings of world government in the United Nations Organization, has also been a momentous year for your Institute. It is now your President's pleasant duty to report to you upon it.

The normal service activities of the Institute have continued. For detailed reports on the National Meetings in New York, Los Angeles, Detroit, and Washington; the Wright Brothers Lecture; and the progress of the Institute's publications, you are referred to the report of the Administrative Committee. There you will also find details of the expanded personnel placement service and of the assistance which the Institute has been able to give to the Army Air Forces in the recruitment of technical intelligence personnel and in the transfer of certain special equipment to educational institutions. Your Institute also cooperated with the Air Forces in arranging two visits of aeronautical executives to the Air Technical Service Command at Wright and Freeman Fields, which were of great interest and value.

Changes have been made in the internal organization of the Institute which should be reported upon. You have recently adopted a new Constitution by the terms of which your Council has been increased from 12 to 28 members. The membership of the Council now comprises the President, four Vice-Presidents, the Treasurer, the Past-President, 15 national Councilors, and six locally nominated Area Councilors whose special responsibility is the representation of the Sections.

To aid in the maintenance and extension of Section activities the Council has recently authorized greatly increased financial assistance from national funds.

Upon the recommendation of the Membership Committee, the Council, at its last meeting, made certain revisions in the grades of membership

E. E. Aldrin

Lawrence D. Bell.

W. A. M. Burden

Charles H. Colvin

Newly Elected and Present Members of the Council

James H. Doolittle.

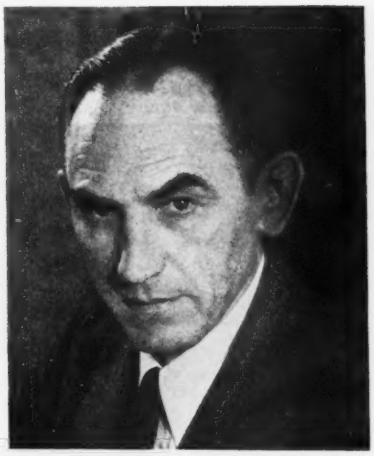
Leroy R. Grumman.

Jerome Lederer.

Earl D. Osborn.

Rex B. Beisel.

George W. Brady.



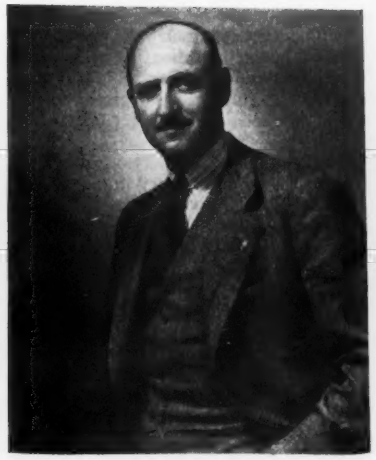
William K. Ebel.

Sherman M. Fairchild.

Lester D. Gardner,
Chairman.

Charles Froesch.

R. Paul Harrington.



Otto E. Kirchner.

Elmer A. Sperry, Jr.

Area Council Members

Eastern

W. Wallace Kellett.

Central

Peter Altman.

Western

Donald W. Finlay.

Fred E. Weick.

Robert J. Minshall.

Ernest G. Stout.

and in the qualifications for membership. These changes remove ambiguities, which made difficult the proper grading of applicants by the Membership Committee, and made the Institute's membership grades more comparable with those of the other professional societies. The appropriate changes in the By-Laws will appear in an early issue of the AERONAUTICAL ENGINEERING REVIEW.

An important step in decentralization has been taken in the opening of a West Coast office in Los Angeles and the engagement of William H. Dudley as Pacific Coast Executive.

Plans have been made for a survey of professional employment in the aircraft and air-transport industries and for a study of the professional activities and interests of the Institute's members.

In cooperation with the National Research Council and with other professional societies your Institute has worked on the liberalization of Selective Service procedures in respect to scientific and engineering personnel and on the release of such persons by the armed forces.

During the year important gifts have been made to the library and museum. Details will be found in the report of the President of the Archives, but special mention should be made of the presentation to the Institute by W. A. M. Burden of a substantial portion of his aeronautical library, and the gift to the museum by the Government of the Union of Soviet Socialist Republics of a complete set of the insignia of the Soviet Air Force. The yearly gifts from Glenn L. Martin to The Minta Martin Aeronautical Fund have been completed, and it is hoped that a plan for the use of the income to the great benefit of the aeronautical profession may soon be announced.

As is fully explained in the report of the Treasurer, the restricted funds of the Institute all stand at higher values, both book and market, than at the beginning of the year.

Daniel Guggenheim Park, the Institute's property at Sands Point, has been leased to the Navy Department which has undertaken important research in which the Institute has been able to be of assistance. It is understood that the entire Special Devices Division of the Office of Research and Inventions will later be installed at Daniel Guggenheim Park, thus putting it fully to the use on aeronautical research originally contemplated when the late Florence Guggenheim presented the property to the Institute.

Your President is happy to express appreciation of the cooperation of the Air Forces and of the Navy, not only last year but throughout the war period, in the clearance of technical papers for presentation at Institute meetings and for publication in the JOURNAL OF THE AERONAUTICAL SCIENCES and the AERONAUTICAL ENGINEERING REVIEW.

Cooperation with our British sister institution, The Royal Aeronautical Society, has continued, and plans are under discussion for extension of relations to include more exchange lectures and technical visits and, it is hoped, an exchange of research fellowships.

Steps have been taken to restore relations between the Institute and the aeronautical scientists and engineers in the U.S.S.R., which were largely suspended during the war, and with those in France with whom we, of course, lost contact during the occupation.

Thanks to the initiative of Major Fleet in 1944, the Institute now has its own building in New York, which was purchased and remodeled during 1945.

Good progress has been made on the Institute's Los Angeles and San Diego buildings, funds for which were raised largely through the efforts of Major Fleet. In both cities architects are now preparing working drawings and construction should be well under way in 1946.

During the year your President had the good fortune to be able to visit and consult with the officers of the San Diego, Los Angeles, Seattle, and Washington sections, as well as with many individual members of the Institute. He wishes to express his thanks to them for their counsel, help, and cooperation. Thanks are also due to the Corporate Members of the Institute for their generous support through dues, to the companies which have supported the AERONAUTICAL ENGINEERING REVIEW and the AERONAUTICAL ENGINEERING CATALOG, and especially to the contributors to the Building Funds in all parts of the country. The Officers and Council are deeply sensible of their obligation to see that the Institute renders services commensurate with such support.

This report would be incomplete without reference to the great services which have been rendered to the Institute by two outstanding men. Lester Gardner has made a reality of Major Fleet's vision of a New York building for the Institute. He found the right building, after looking at more than a dozen, and negotiated its purchase. He worked out the zoning and occupance problems. He planned and directed the remodeling. He supervised the moving. Without thought for his health or comfort he went to the building almost daily throughout the whole long period of reconstruction and redecoration. The members should know of his devotion.

Not less remarkable in his continuous and selfless assistance to the Institute has been its volunteer counsel, Allan D. Emil. He was a tower of strength in the building purchase and remodeling, and his wise and ready advice on all legal matters has been of the greatest help to the Council, to Major Gardner, and to your President.

Finally, a word of appreciation to the Institute's staff. For them, with the problems of the purchase, remodeling, and redecorating of the new building, the opening of the West Coast Office, the California Buildings, and expanded service activities superimposed on their normal duties, the year has been a very trying one. They have all accepted their added burdens cheerfully and effectively and have done their jobs in a truly magnificent way. It is a duty and a pleasure to thank them on behalf of the entire membership.

CHARLES H. COLVIN

Treasurer's Annual Report

The accompanying Financial Statement for the fiscal year ended September 30, 1945, comprises a consolidated balance sheet showing the assets, liabilities, and unexpended income of the Institute; a consolidated statement of income and expenses; and details of the income and expense of the JOURNAL OF THE AERONAUTICAL SCIENCES, the AERONAUTICAL ENGINEERING CATALOG, and the Archives and AERONAUTICAL ENGINEERING REVIEW.

Your Treasurer wishes to point out that the Institute is a scientific society to which the Government encourages contributions by liberal tax provisions. The Institute has received many substantial gifts, most of which have been restricted by the donors to particular uses and in respect to which the Institute acts in a fiduciary capacity. Such funds are shown on the balance sheet as "restricted" and are separate and distinct from the working funds of the Institute.

Significant changes in the restricted funds during the year have been the increase in The Minta Martin Aeronautical Fund from $331,687.21 to $439,817.45; The Lawrence Sperry Award Fund from $10,328.76 to $11,598.88; The Vernon Lynch Award Fund from $15,908.25 to $17,260.00; and The Sherman M. Fairchild Fund from $25,967.93 to $28,883.95.

The aeronautical industry and generous individuals have contributed funds for the purpose of providing library research facilities and meeting rooms for the membership in San Diego, Los Angeles, and New York.

The capital assets shown on the financial statement do not include the value of the Libraries, Aeronautical Index, Daniel Guggenheim Park and the Archives collections. These are carried on the books at $1.00. Were they based on their cost, gift value, or assessed valuation, they would materially increase the total assets.

The Reserves for Postwar Contingencies are fully invested in Treasury Bonds. These postwar funds were set aside by your Council to provide for increased activities during postwar years, as well as adequate reserves for regular operations.

As reported last year, the Council approved a Retirement Pension Plan to provide an incentive for the staff to continue in the employ of the Institute. This plan has been approved by the U.S. Treasury Department and is now in effect.

As of September 30, 1945, the investments of the Institute, restricted and general, had a market value, in excess of our book value, of over $154,000, indicating the sound judgment of the Finance Committee in directing the investment policy of the Institute.

As in previous years, the details of the operations of the Institute are presented under their appropriate headings to enable the membership to see the costs of the various functions. Because the REVIEW was started from the library endowment, the Council directed that any income above expenses of the REVIEW be set aside for the support of the library, index, and other services of the Archives.

The books of account of the Institute were examined by Patterson and Ridgway, Certified Public Accountants. In their report they advise that the Balance Sheet and related statement of income and expenses fairly present the financial position of the Institute at September 30, 1945, and the results of operations for the fiscal year ended that date. [*See* page 44.]

EARL D. OSBORN

Administrative Committee Report for 1945

The thirteenth year of the Institute, the year of victory after a war employing the greatest use of air power, brought with it many new and critical problems. However, most of the services to Institute members and the industry were increased during the year. New Sections and Student Branches were organized and the growth in membership continued at a steady rate. The dissemination of technical information continued in the Institute's publications

INSTITUTE OF THE AERONAUTICAL SCIENCES, INC.

Statement for the fiscal year October 1, 1944, to September 30, 1945

Consolidated Balance Sheet

ASSETS

General Fund Assets:		
Cash on Deposit and Petty Cash		$ 20,635.01
Advances and Loans Receivable		6,605.12
Accounts Receivable		57,405.51
Deposits and Prepayments		2,168.61
Furniture and Fixtures		5,000.00
Investment Accounts:		
Benefactor Membership Fund:		
U.S. Treasury and Savings Bonds at par	47,000.00	
Postwar Contingencies Fund:		
U.S. Treasury Bonds at par	118,000.00	
Daniel Guggenheim Park (Assessed Value—$513,750.00)	1.00	
Books, Prints, Models, Medals, etc.	1.00	
Aeronautical Index	1.00	
Total General Fund Assets		$256,817.25
Aeronautical Archives Assets:		
The Paul Kollsman Fund (restricted):		
U.S. Treasury Bonds at par	$ 65,000.00	
Postwar Contingencies Fund:		
U.S. Treasury Bonds at par	63,000.00	
Accounts Receivable	11,111.24	
Cash on Deposit	9,322.82	
Total Aeronautical Archives Assets		$148,434.06
Restricted Fund Assets:		
The Sherman M. Fairchild Fund:		
U.S. Treasury Bonds at par	$ 28,000.00	
Cash on Deposit	883.95	$ 28,883.95
The Vernon Lynch Award Fund:		
U.S. Treasury Bonds at par	3,000.00	
Stocks	14,260.00	17,260.00
The Minta Martin Aeronautical Fund:		
U.S. Treasury Bonds and Stocks	429,364.40	
Cash on Deposit	10,453.05	439,817.45
The Sylvanus A. Reed Award Fund:		
U.S. Treasury Bonds at par	11,000.00	
Cash on Deposit	749.08	11,749.08
The Lawrence Sperry Award Fund:		
U.S. Treasury Bonds at par	11,000.00	
Cash on Deposit	598.88	11,598.88
New York Building Fund:		
U.S. Treasury Bonds at par	135,000.00	
Building and Property	112,353.11	
Taxes Prepaid	4,208.91	
	251,562.02	
Less—Advance from General Fund	1,062.02	250,500.00
Los Angeles Building Fund:		
U.S. Govt. C. of I. at par	160,000.00	
Building (in process) and Land	79,109.32	
Cash on Deposit	20,494.92	259,604.24
San Diego Building Fund:		
Certificates of Deposit	155,500.00	
Building (work in process)	1,992.00	
Cash on Deposit	7,709.25	165,201.25
Total Restricted Fund Assets		$1,184,614.85

LIABILITIES, FUNDS AND UNEXPENDED INCOME

General Fund:		
Accounts Payable		$ 21,697.43
Deferred Credits to Income (Dues & Subscriptions)		38,193.66
Reserve for Postwar Contingencies		166,000.00
Unexpended Income:		
Balance September 30, 1945		30,926.16
Total General Fund Liabilities and Unexpended Income		$256,817.25
Aeronautical Archives:		
The Paul Kollsman Fund Principal (restricted)		$ 65,000.00
Accounts Payable		5,693.83
Deferred Credits to Income		220.00
Reserve for Postwar Contingencies		63,000.00
Unexpended Income:		
Balance September 30, 1945		14,520.23
Total Aeronautical Archives Liabilities and Unexpended Income		$148,434.06
Restricted Funds:		
Principal of gifts and unexpended income (See Assets)		
Total Restricted Funds Liabilities		$1,184,614.85

Statement of Income and Expenses—General

INCOME		
Dues (less subscriptions)	$127,861.02	
Entrance Fees	2,375.00	
Interest on Investments	5,710.21	
Miscellaneous	1,002.50	
Excess of Income over Expenses:		
Aeronautical Engineering Catalog	22,678.82	
Total Income		$159,627.55
EXPENSES		
Accounting and Clerical Salaries	$ 31,021.88	
General Office Expenses	34,747.36	
Provision for Postwar Contingencies	78,000.00	
Excess of Expenses over Income:		
Journal of the Aeronautical Sciences	451.28	
Total Expenses		144,220.52
Net Unexpended Income for the Period Ending September 30, 1945		$ 15,407.03

Statement of Income and Expenses—Aeronautical Archives

INCOME		
Revenue	$184,598.09	
Subscriptions	9,642.58	
Interest on Investments	588.10	
Total Income		$194,828.77
EXPENSES		
Aeronautical Archives and Libraries	$ 56,482.62	
Editorial and Clerical Salaries	37,134.25	
General and Publication Expenses	79,936.81	
Provision for Postwar Contingencies	20,000.00	
Total Expenses		193,553.68
Net Unexpended Income for the Period Ending September 30, 1945		$ 1,275.09

Detail of Journal and Catalog Income and Expenses

Journal

INCOME		
Subscriptions	$ 24,556.27	
Total Income		$ 24,556.27
EXPENSES		
Editorial and Clerical Salaries	$ 14,100.85	
General and Publication Expenses	10,906.70	
Total Expenses		25,007.55
Excess of Expenses over Income—See Institute Expenses		$ 451.28

Catalog

INCOME		
Revenue	$ 59,180.76	
Total Income		$ 59,180.76
EXPENSES		
Editorial and Clerical Salaries	$ 11,372.89	
General and Publication Expenses	25,129.05	
Total Expenses		$ 36,501.94
Excess of Income over Expenses—See Institute Income		$ 22,678.82

and at local Section meetings. Four national meetings had to be canceled to comply with the request of the Office of Defense Transportation to limit travel and the holding of large national gatherings.

In addition to the regular listing of "Personnel Opportunities" in the AERONAUTICAL ENGINEERING REVIEW, a bulletin service to the industry was started to further assist members, particularly those discharged from the armed services, in obtaining positions in the industry.

A new building in New York was purchased and remodeled, and plans were made for further expanding and broadening the services of the Aeronautical Archives and the activities of the Institute.

Membership

The total individual membership of the Institute at the close of the year 1945 was 7,184.

Comparison of membership distribution by grades for 1944 and 1945 is given below.

	1944	1945
Honorary Members	17	18
Honorary Fellows	18	18
Fellows	157	166
Associate Fellows	453	533
Members	1,372	1,704
Industrial Members	299	321
Technical Members	3,225	3,264
Affiliates	126	134
Student Members	857	1,035
	6,524	7,193

During the calendar year 788 new members were admitted to the grades of Technical Member and above. Of these, 194 were transferred from the grade of Student Member to Technical Member. The other 594 were new applicants elected to membership by the Admissions Committee. Student Membership increased in 1945 by 178.

Twenty-three members of the Institute died during the year, 249 were dropped for nonpayment of dues, and 42 resignations were received. Twenty-two former members were reinstated. The net increase in graded members was 474. The total net gain in membership was 669.

Corporate Membership enrollment reached 182 during 1945. Eighteen companies became new Corporate Members and eleven resigned. The dues of Corporate Members permitted the Institute to publish the highly regarded JOURNAL OF THE AERONAUTICAL SCIENCES without advertising and helped to defray the expenses of other services, such as those of national meetings, which were held without registration fees for members.

Sections and Branches

Thirteen active sections of the Institute held 57 local meetings during the year and 36 active groups in Colleges and Technical Schools held 243 Student Branch meetings. A new section was organized in Miami, and plans were made for the organization of a Boston Section. Twenty-five Student Branch Awards were presented for scholastic achievement and for the presentation of the best technical papers.

National Meetings

The regular schedule for national meetings was disrupted by the request of the Office of Defense Transportation to curtail all meetings at which more than 50 people would be in attendance from out of the city in which the meeting was held. As a result, the Technical Sessions and the Honors Night Dinner of the Thirteenth Annual Meeting had to be canceled on short notice.

The Honors and Awards of the Institute usually presented at the Honors Night Dinner were given instead at a meeting held in the auditorium of the Engineering Societies Building in New York in January, 1945. The National Light Aircraft Meeting, scheduled for Detroit in April, was also canceled. This meeting and that of the National Summer Meeting in Los Angeles were later held on a local basis to comply with the request of the Office of Defense Transportation. The regular national meetings schedule was resumed again beginning with the Air Transport Meeting in Washington, D.C., in October. This was followed by the Ninth Wright Brothers Lecture presented by Dr. H. Roxbee Cox, on December 17. The schedule of national meetings for the year beginning March, 1946, is as follows:

Aircraft Propulsion, March 21–22.....Cleveland, Ohio
Light Aircraft, June 13–14.....Detroit, Mich.
Annual Summer Meeting, August 15–16...Los Angeles, Calif.
Air Transport, October..Washington, D.C.
Wright Brothers Lecture, December 17.....New York, N.Y.
Honors Night Dinner, January 27, 1947.....New York, N.Y.
Annual Technical Sessions, January 28–30...New York, N.Y.

At the invitation of the Commanding Generals of the Air Technical Service Command, two tours of inspection of Wright and Freeman Fields were made by limited groups of Institute members on September 13–14 and 21–22. The Administrative Committee wishes to express its appreciation for the fine cooperation of the Officers and Staff of both fields in preparing an extremely interesting and informative program.

Members of the staff of the Institute traveled over 30,000 miles during the year in connection with Institute meetings and other activities.

Publications

The removal of paper restrictions enabled the JOURNAL OF THE AERONAUTICAL SCIENCES to resume publication as a monthly, beginning with the January issue. The AERONAUTICAL ENGINEERING REVIEW and JOURNAL OF THE AERONAUTICAL SCIENCES have returned to the previous large trim size, the reduction of which was made necessary in 1943 by the War Production Board's paper limitation order. Late

Sections of the Institute

Buffalo, N.Y.
Cleveland, Ohio
Detroit, Mich.
Los Angeles, Calif.
Miami, Fla.
New York, N.Y.
Philadelphia, Pa.
Phoenix, Ariz.
San Diego, Calif.
Seattle, Wash.
Texas (Fort Worth-Dallas)
Washington, D.C.
Wichita, Kan.

Active Student Branches

A & M College of Texas
Academy of Aeronautics
Aeronautical University
University of Alabama
Alabama Polytechnic Institute
California Institute of Technology
Carnegie Institute of Technology
Case School of Applied Science
Catholic University of America
University of Cincinnati
University of Colorado
University of Detroit
Georgia School of Technology
University of Illinois
Illinois Institute of Technology
Indiana Technical College
Iowa State College
University of Kansas
Louisiana State University
Massachusetts Institute of Technology
University of Michigan
University of Minnesota
New York University
North Carolina State College
Notre Dame University
University of Oklahoma
Polytechnic Institute of Brooklyn
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Spartan College
University of Texas
Tri-State College
The University of Tulsa
Virginia Polytechnic Institute
University of Washington
University of Wichita

in 1945 the Institute was able to announce that it again could accept nonmember subscriptions to the JOURNAL and the REVIEW. Within 60 days, over 300 subscriptions to both publications were received. It is believed that, when it is generally known that these useful publications can be secured by other than members, a large group of engineering specialists who are not eligible for membership in the Institute will wish to avail themselves of the opportunity of keeping themselves informed about the progress of aeronautics as reported in the reviews of books, articles, and releases appearing in the AERONAUTICAL ENGINEERING REVIEW.

An improvement in the make-up of the REVIEW was effected with the October issue by publishing all technical articles on consecutive pages. Further improvements in editorial content and arrangement are planned.

The AERONAUTICAL ENGINEERING REVIEW carried 37 technical articles requiring 197 pages. Over 4,000 reviews and abstracts of articles appearing in periodicals, books, technical reports, house organs, press releases, and catalogs were published during 1945. Five hundred and ninety-nine pages of timesaving references to published information were printed. Since publishers send newly published books for review in the AERONAUTICAL ENGINEERING REVIEW, accessions to the Institute's libraries from this source are large. During 1945 over 550 books were thus received.

The JOURNAL OF THE AERONAUTICAL SCIENCES published 60 technical papers on 495 text pages. These scientific and engineering reports and disclosures, even though more important papers had to be withdrawn because of government restrictions, continue to make the JOURNAL one of the most highly regarded scientific publications in the world. An indication of the appreciation of its standing is the demand for back numbers from abroad from aeronautical scientists who could not receive them during the war period.

The AERONAUTICAL ENGINEERING CATALOG was improved and expanded over the first edition distributed in 1944. Listed in its more than 600 pages were the sources of supply of over 2,000 items manufactured by more than 1,800 companies. Despite a reduced-type spacing, new information required 142 additional pages. The editors of the CATALOG were gratified to receive a large and favorable response from members and other users regarding the value and usefulness of this publication. Approximately 7,000 copies were distributed without charge to members and other selected key personnel in the aircraft industry. The 1946 Edition of the CATALOG is now in preparation, for which over 3,000 requests have already been received.

The Institute's New Building

For several years the Institute has been occupying space in Rockefeller Center inadequate for its administrative, editorial, library, and Archives requirements. Additional space at a rental the Institute could afford was impossible to obtain in New York. Through the efforts of Major R. H. Fleet, a fund was raised for the purchase of a building.

After examining and rejecting many other properties, the former residence of the late E. J. Berwind at 2 East 64th Street was found to be adaptable to the needs of the Institute and available at an acceptable price. Members will learn more of the services to be provided when the building is completely equipped and available for their use.

New West Coast Office

To render greater service to the Pacific Coast members of the Institute, the Administrative Committee with the approval of Officers and the Council appointed William H. Dudley as Pacific Coast Executive, with offices in The Pacific Aeronautical Library in Hollywood, Calif. The Pacific Coast Executive coordinates the activities of the society in that region in cooperation with Institute and Section officers.

Special Services

The Institute was asked to assist the Air Technical Service Command in locating special technical personnel to go overseas for the purpose of exploiting captured enemy scientific documents. From the names submitted by a special committee, ten members of the Institute were selected for this important research work. They were attached to the Air Document Research Center and spent from 2 to 5 months abroad.

Late in 1945, a committee of the Institute was appointed to assist the Army Air Forces in the disposal of surplus aeronautical equipment to universities and engineering schools for educational purposes. By the close of the year this committee was instrumental in disposing of many pieces of electronic equipment to these educational organizations at the cost of the shipping alone

During the early years of the Institute it became a center where its distinguished foreign members and guests introduced by them could be welcomed and aided in making their visit to this country both pleasant and helpful. Letters of introduction were given and suggestions made as to how visitors could plan their tours most efficiently. Because foreign members have always been appreciative of their connection with the Institute and were hospitably kind to members who made trips to Europe, many introductions were made, a service that was greatly appreciated. When the war came the Institute was able to render similar continuous service to foreign visitors. Since V-J Day the steady flow of guests from Europe has again commenced and the officers and staff are expecting that this friendly service will increase next year.

Plans are being made to print a new Roster of Members. The difficulty of procuring paper and the many pressing duties of the limited staff have prevented the preparation of this valuable reference book for members.

The management of the Institute's properties at Sands Point, Long Island, and in New York requires constant supervisory administration. Daniel Guggenheim Park is now being used by the Navy for research, but with the prospect of having to operate three new buildings by the end of 1946, your Administrative Committee is making plans so that this can be done with the least amount of time being taken from regular Institute work.

Appreciation

In closing its report for 1945 the Administrative Committee wishes to express its appreciation to the Officers and Council for their cooperation and guidance. It also wishes to express its appreciation to the employees of the Institute. Through their loyalty and efforts the Institute was able to maintain its services during this critical year. It is hardly necessary to recall the personnel problems encountered under war conditions when the turnover of the employees of the Institute reached 50 per cent annually.

The Committee also wishes to thank all members, both corporate and individual, for their cooperation during the difficult period of moving to the new building when library and other services had to be temporarily interrupted.

BENNETT H. HORCHLER, *Chairman*
GEORGE R. FORMAN
ROBERT R. DEXTER
JOSEPH J. MAITAN

Report of the President of the Aeronautical Archives, 1945

The Aeronautical Archives consists of The W. A. M. Burden Library, The Paul Kollsman Library, the Aeronautical Indexes and Collections, and the AERONAUTICAL ENGINEERING REVIEW.

The establishment of the Archives in 1940 was made possible by the generosity of several Institute members. W. A. M. Burden lent his aeronautical library of nearly 12,000 volumes to be used as a reference library by Institute

members and other research workers. This year Mr. Burden gave a large part of the bound periodicals in his library to the Archives. This gift will be described in detail later in the report.

Paul Kollsman and the Square D Company gave $50,000 for the establishment of a free lending library. Of this fund, $10,000 was used to organize the Library. Mr. Kollsman has increased the original gift to a permanent fund of $65,000. The income from this fund, together with a yearly contribution of $5,000 from the Square D Company as a Corporate Member of the Institute, is used to maintain The Paul Kollsman Library.

The membership in The Paul Kollsman Library increased during the year from 3,661 to 4,103, adding a total of 442 new members. The number of books lent during the year was 1,224, and the total number lent since the Library was established is 7,906.

Books Added to the Libraries

The number of books added to the Libraries during the year was 2,326. Of these, 632 were purchased, 558 were review copies of new books sent to the AERONAUTICAL ENGINEERING REVIEW, 259 were newly bound periodicals, and 877 were gifts. The total number of books in the Libraries of the Institute is 30,605.

In addition to books, 182 *R.T.P. Translations* of the British Air Ministry were received, bringing the total number of these publications in the Archives to 1,183. Requests for 712 of these were filled during the year, 509 by loan and 205 by photostat.

In keeping with the policy of collecting aeronautical source material of all kinds, 259 letters to periodicals published in 41 foreign countries were sent as soon as possible after the end of the war. The 47 replies to date have included files of 35 periodicals from eleven countries and replies stating that twelve periodicals have suspended publication. Documents relating to applications for new air routes and extensions of existing routes before the Civil Aeronautics Board have been received regularly from air lines, and the Archives has more than 200 of them.

Reference Service

The facilities of the Aeronautical Archives were used in person by 305 persons 744 times. These 305 persons called for 1,037 books and magazines, or an average of 3.4 books and magazines per visit. There were 723 telephone calls for information, and 483 persons visited and inspected the Archives without making use of the collections for reading purposes. The Archives filled 499 orders for photostat copies, calling for 939 separate articles.

A summary of the statistical data of the Libraries is given in table form on this page.

Gifts to the Aeronautical Archives

The continuing interest and support of the many friends of the Aeronautical Archives was shown during the year by 261 gifts. The names of E. E. Aldrin, W. A. M. Burden, C. D. Hanscom, Alexander Klemin, A. Roy Knabenshue, Mrs. Bella C. Landauer, and Edward P. Warner are only a few of those which appear regularly in these reports and in the acknowledgments in the AERONAUTICAL ENGINEERING REVIEW. Its friends have brought the Archives to its present condition of completeness, and without their loyal support many of its possessions could not have been acquired.

Books, Periodicals, Clippings

W. A. M. Burden collected books and periodicals for many years to form the largest privately owned aeronautical library in the country. He generously placed it in the Aeronautical Archives in 1940 for use as a reference library. This year Mr. Burden gave the Archives all the bound volumes of periodicals in his library from Austria, Belgium, Great Britain, Italy, Rumania, Sweden, and the United States, and all his bound volumes of international aeronautical periodicals. The complete files of the principal periodicals published in seven countries are included in this gift of 864 bound volumes. Mr. Burden included the steel shelving of his entire library with the gift, which is valued conservatively at a total of $10,000.

L'Aviation Illustrée from January, 1909, to February 1, 1911, was given by Allan D. Emil. Mr. Emil also gave *Unsere Luftstreitkräfte, 1914–1918*, Berlin, 1930, edited by Gen. Walter von Eberhardt. The *Giornale dell'Aviatore*, published by the Mediterranean Allied Air Forces for the Italian Air Force, was sent through the courtesy of Lt. Gen. Ira C. Eaker.

More than 50 publications of the French Air Ministry, published during the war, were received from the French Air Mission in the United States. The Association Française des Ingenieurs et Techniciens de l'Aéronautique gave a file of its publication, *Technique et Science Aéronautiques*. Dr. Raffaele Giacomelli gave his book, *Il Terrorismo Aereo, Nella Teoria e Nella Realta*, Rome, 1945, with a supplement on the atomic bomb.

A scrapbook of A. Leo Stevens, the aeronautical pioneer, covering his career

Library Statistics

October 1944–September 1945

The Paul Kollsman Lending Library

Total Library Membership	4,103
Total Number of Books Loaned	7,906
New Members, October 1944–September 1945	442
Books Loaned, October 1944–September 1945	1,224

The W. A. M. Burden Library

Days Open	267
Readers	744
Telephone Calls for Information	723
Total Users	1,467
Photostat Orders	499
Visitors	483

Statistics on Books Added to the Libraries October 1944–September 1945

	Bound Periodicals	Gifts	Review Copies	Purchases	Totals
Books Added to The I.A.S. Library		877	558	632	2,067
Books Added to The W. A. M. Burden Library	259				259
	259	877	558	632	2,326

Volumes in the Libraries as of September 30, 1945

The I.A.S. Library		The W. A. M. Burden Library		The Pacific Aeronautical Library		Totals
Accessions	13,272	Bound Periodicals	3,081	Accessions	1,971	
Duplicates	2,895	Books	5,262			
N.A.A. Duplicates	148	Russian Books	75			
		Japanese Books	278			
N.A.A. Bound Periodicals	141	Chinese Books	482			
		Pamphlets (Approx.)	3,000			
	16,456		12,178		1,971	30,605

FREE!

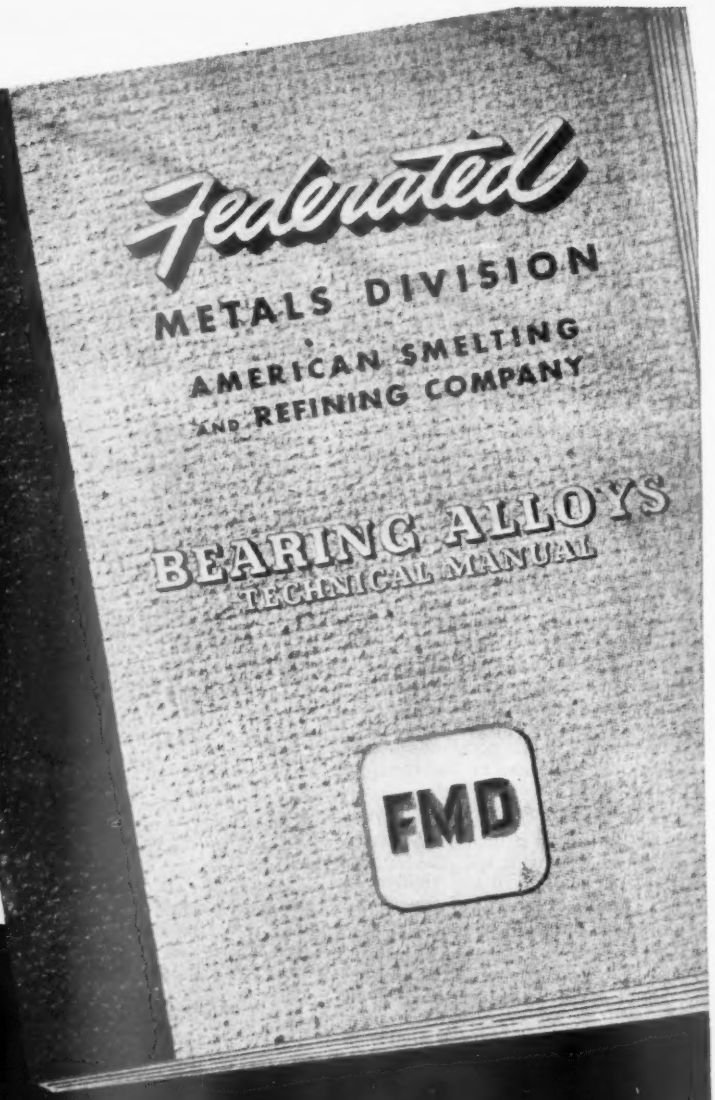
UP-TO-THE-MINUTE

FACTS

WAYS, MEANS, USES OF

BEARING ALLOYS

A detailed discussion of white metal bearing alloys—valuable to anyone concerned with production, maintenance, and repairs.



MAIL THIS COUPON NOW!

FMD Federated

Federated Metals Division—Dept. AER-3
American Smelting and Refining Company
120 Broadway, New York 5, N. Y.

Please send me a FREE copy of Bearing Alloys Technical Manual.

Name_____

Address_____

City_____ State_____

Company Name_____

from 1908 to 1942, was sent by Mrs. A. Leo Stevens. Col. J. Carroll Cone gave a book of aeronautical clippings covering the period July, 1934, to March, 1935. Letters and clippings of Samuel Cabot were received from Mrs. Samuel Cabot.

Among the donors of periodicals were Aero Insurance Underwriters, Inc., 287 issues; Aeronautical Digest Publishing Company, 253 issues; *Aviation*, 303 issues; W. A. M. Burden, 750 issues; British Information Services, 62 issues; Curtiss-Wright Corporation, 410 issues; Eclipse-Pioneer Division of Bendix Aviation Corporation, 275 issues; Fairchild Engine & Airplane Corporation, 128 issues; Sperry Gyroscope Company, Inc., 400 issues.

Air-Mail Covers and Labels

John P. V. Heinmuller added to the notable collection of flight covers which he generously presented to the Archives last year. W. Donald Thomas gave 160 domestic and foreign air labels, and H. Schoenfeld gave 26 air labels. These gifts added to the air label collections generously donated previously by W. A. M. Burden, Mrs. Bella C. Landauer, and others.

Models

Paul Guillow gave 27 historical models of heavier-than-air craft before 1903. The earliest of these representations is the glider of Sir George Cayley, 1804, and the collection shows the development of the airplane from that date to the first powered flight by the Wright Brothers in 1903. The Wright biplane kite, their biplane glider of 1900, and their airplane of 1903 are included. Models of man-carrying gliders built and flown by Chanute, Montgomery, Lilienthal, Wenham, and Le Bris are included. Model gliders of Penaud, Loup, and Walker, and airplanes built but not flown by Du Temple in 1857, Moy, Chanute, and Herring in 1897, and Langley in 1903, are represented. The collection includes a reproduction of the 1842 airplane of Henson and Stringfellow, and of their model of 1848 which was the first powered model to be flown. The idea of Penaud and Gauchot for a large flying wing in 1876 is represented as well as the man-carrying box kite of Hargrave of 1893.

Col. H. F. Gregory sent a model of the Sikorsky XR-4 helicopter. Col. T. B. Holliday sent a model of the German V-1 flying bomb. Among other donors of airplane models were Beech Aircraft Corporation, Boeing Aircraft Company, Chance Vought Division of United Aircraft Corporation, and Grumman Aircraft Engineering Corporation. The Archives contains more than 450 models because of these and other generous gifts.

Insignia

The Government Purchasing Commission of the Soviet Union in the U.S.A., through the courtesy of Col. I. P. Kramarenko, gave 62 Red Army Air Forces insignia. The British Fleet Air Arm gave 30 of its insignia. Gifts of companies and individuals during the year increased the insignia collection to more than 1,950 pieces.

Prints, Music, Trade Cards, Bookplates, Invitations, Calendars, and Christmas Cards

A portrait etching of Dr. John Jeffries was received from Mrs. James Means. The Wright Aeronautical Corporation sent a portfolio of colored lithographs of modern aviation "firsts" by Frank Lemon. Additions to the collections have been made steadily by the many friends of the Aeronautical Archives.

Photographs

The Sherman Fairchild Collection of Aeronautical Photographs increased from 6,300 to 10,000 through the gifts of companies and individuals. Many companies sent photographs of all airplanes they have manufactured, with lists of the airplanes. C. D. Hanscom gave 85 historical photographs.

Slides, Films, and Recordings

The British Joint Staff Mission gave 600 slides showing results of Allied bombing in Europe, and a steropticon for viewing them. Sound moving pictures were received from the Lockheed Aircraft Corporation and Wright Aeronautical Corporation. A recording of the First Annual Air Force Day, including speeches by Gen. H. H. Arnold and others, was sent by radio station WOR. A 16-side recording of the dedication of the Southern California Cooperative Wind Tunnel, May 3, 1945, was presented by the International Business Machines Corporation.

A 36-in. globe used in planning air routes pioneered by Pan American Airways, Inc., was given by Juan T. Trippe.

The Aeronautical Archives will be adequately housed at Fifth Avenue and 64th Street, into which it was moved early in 1946. There is adequate space for the displays and for the expanding libraries, and their usefulness will be greatly increased in the new quarters.

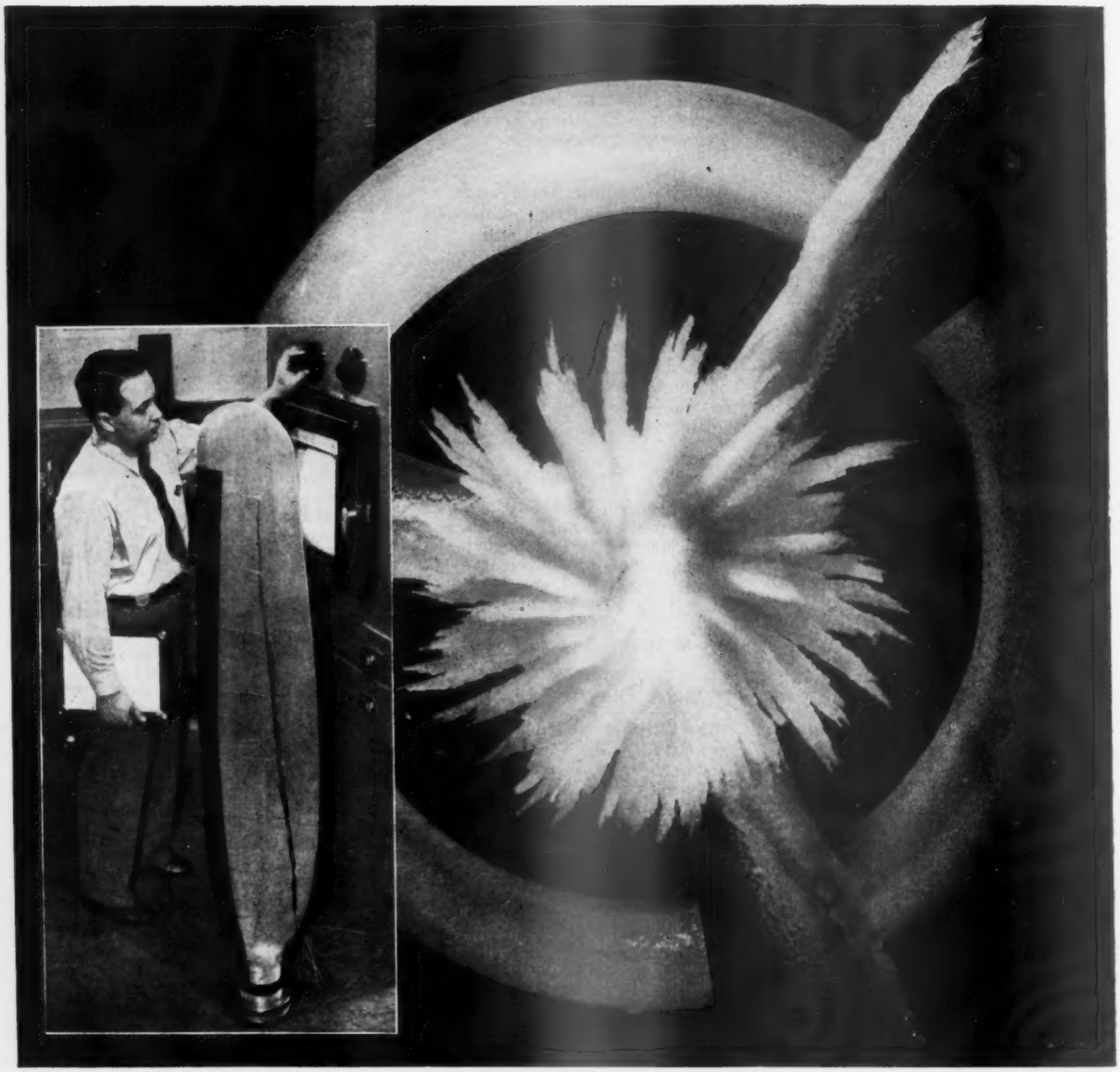
LESTER D. GARDNER

Companies Whose Representatives Used the Archives in Person, 1945

Manufacturing and Business Firms

Aluminum Company of America, Inc.
American Airlines, Inc.
American Overseas Airlines, Inc.
Argus Research Corporation
Aviation Corporation
N. W. Ayer & Son, Inc.
BG Corporation
Ballard Corporation Company, Inc.
Bell Telephone Laboratories, Inc.
Bendix Aviation Corporation
Bendix Helicopter, Inc.
Brach, Grosswein & Levine
Bulova Watch Company
Campbell-Ewald Company, Inc.
Carrier Corporation
Columbia Aircraft Corporation
Columbia Broadcasting System, Inc.
Columbian Carbon Company
Consolidated Vultee Aircraft Company
Control Instrument Company, Inc.
Curtiss-Wright Corporation
Eastern Air Lines, Inc.
Fairchild Engine & Airplane Corporation
Frank, Albert, Guenther, Law, Inc.
General Aviation Equipment Company
General Electric Company
Grant Advertising, Inc.
Grumman Aircraft Engineering Corporation
Gulf Oil Corporation
International Nickel Company, Inc.
Jacobson & Company, Inc.
Kollsman Instrument Division, Square D Company
Arthur Kudner, Inc.
Lawrance Aeronautical Corporation
Lear, Incorporated
S. D. Leidesdorf & Company
Link Aviation Devices, Inc.
McCann-Erickson, Inc.
L. E. McGivena & Company, Inc.
The Glenn L. Martin Company
J. M. Mathes, Inc.
National City Bank of New York
Newell Emmett Company
Otis Elevator Company
Pan American Airways, Inc.
Pastene & Company, Inc.
Platt-Forbes, Inc.
Republic Aviation Corporation
Retail Credit Company
Ruthrauff & Ryan, Inc.
Shell Oil Company, Inc.
Simmonds Aerocessories, Inc.
Specialties, Inc.
Sperry Gyroscope Company, Inc.
Standard Oil Company of New Jersey
Herbert H. Stevens, Jr.
Sylvania Electrical Products, Inc.
Thompson Products, Inc.
Timken Roller Bearing Company, Inc.
Titeflex, Inc.
Twentieth Century Fox Film Corporation
Union Aircraft Products Corporation
United Aircraft Corporation
United States Rubber Company
Universal Trading Corporation
Van Doren, Nowland, & Schladermundt
Vermilye Company
Irwin Vladimir & Company, Inc.
George P. Wagner Associates
Wallace & Tiernan Company, Inc.
Western Electric Company, Inc.
Wortman, Barton, & Goold, Inc.
Wright Aeronautical Corporation
York Research Corporation
Young & Rubicam

(Continued on page 135)



Push-button defrosting for planes

AN 80-MILE WIND, roaring through the B. F. Goodrich refrigerated wind tunnel, created the Jack Frost effect on the propeller model above.

The exaggerated ice flower on the hub isn't as serious as it looks; but fingers of ice, creeping up the blades, were a big worry to pilots for years. For in flight, ice on the blades means loss of power, bad balance, and excessive vibration.

To a pilot, the smaller picture looks a lot better. It's a propeller equipped with a new B. F. Goodrich development called an electrically heated propeller shoe. It's shown here being tested (the wires are part of the testing equipment; they are not on the blade in flight).

With these shoes on his propeller blades, a pilot can defrost them as simply as a housewife defrosts a refrigerator . . . and lots quicker. The pilot just touches a switch and electric current begins to generate heat in the shoe, which melts off ice.

B. F. Goodrich equipment protects many other parts of the airplane from ice. Best known are the De-Icers, which crack ice off as it forms on wings and tails, keeping these surfaces clean and smooth for safer flying. De-Icers were developed and are made exclusively by B. F. Goodrich. Years of ice-fighting experience are back of this equipment. It means a safer, more comfortable flight if you fly today or when you fly tomorrow. *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

Skyway or Highway

B.F. Goodrich

FIRST IN RUBBER

Institute News

Capt. S. Paul Johnston, U.S.N.R., to Join Institute

Capt. S. Paul Johnston, U.S.N.R., was appointed Director of the Institute at a meeting of the Council held on January 30, and will take over direction of the Institute in April. He will be the chief administrative officer of the Institute, managing its affairs in accordance with the policies established by the Council, and will direct the activities of its other administrative officers.

Captain Johnston was born in Pittsburgh, Pa., where he attended the public schools and Carnegie Institute of Technology. In World War I he was a Cadet Pilot in the U.S. Army Air Service, attending ground school at Princeton University. In 1921 he was graduated from the Massachusetts Institute of Technology. For the next 8 years he was employed by the Aluminum Company of America. In 1930 he joined the editorial staff of *Aviation* magazine and in 1936 became Editor. In 1940 he was appointed Coordinator of Research of the National Advisory Committee for Aeronautics and for a time served as Executive Assistant in the establishment of aircraft activities of the War Production Board. For 2 years he was the Washington Manager of the Curtiss-Wright Corporation.

Commissioned Lieutenant Commander, U.S.N.R., in 1938, he attended the Naval Reserve Officers Indoctrination School at Anacostia, Va., in 1941. Called to active duty in 1944, he served with the Naval Air Transport Service, Pacific, as Engineering Officer, stationed at Honolulu. He was promoted to the Rank of Commander in January, 1945, and became Deputy Director, Aircraft Division, U.S. Strategic Bombing Survey. After duty in England, Germany, and France he was transferred for similar duties at Tokyo. Last December he was promoted to the rank of Captain, U.S.N.R., and in January was awarded the Legion of Merit for his services with the Bombing Survey.

The author of many technical articles, some of which have appeared in *The Saturday Evening Post*, the *Technology Review* and *Aviation* magazine, he has written *Horizons Unlimited*, *Flying Fleets*, *Flying Squadron*, and *Wings after War*. He collaborated with Dr. Edward P. Warner in the preparation of the *Aviation Handbook*.

Captain Johnston is a member of the Aeronautical Engineering Advisory Council of Princeton University.

S. Paul Johnston

Royal Aeronautical Society Celebrates 80th Anniversary

The Royal Aeronautical Society, of Great Britain, oldest aeronautical society in the world, celebrated its 80th anniversary on January 11. Charles H. Colvin, President of the Institute for 1945, expressed the congratulations of the Institute in a cable to the Society, which was read at the dinner marking the occasion held at the Guildhall, London. The text of the cable is as follows:

> "Institute of the Aeronautical Sciences sends greetings and salutations to the oldest and most distinguished aeronautical Society in the world on its eightieth birthday. May the great contributions to the aeronautical sciences your Society has made during the last four score years continue to encourage aeronautical scientists to ever greater accomplishments. The Institute which was founded by members of your Society hopes that the cordial relationship of our Societies may become even closer. Happy Birthday to you."

Library Services Resumed

The moving of the libraries to the new headquarters of the Institute at 2 East 64th Street has been completed, and the facilities of the libraries are again available to members. The Reading Room will be open from 9:30 a. m. to 5:00 p.m., Monday through Saturday.

The book-lending service of The Paul Kollsman Library, which was temporarily suspended, has been resumed.

Veterans Rejoin Institute Staff

Lt. James J. Coltiletti, recently honorably discharged from the U.S. Army Air Forces, has rejoined the Institute staff after 4 years' absence. He will assist George R. Forman, Assistant to the President.

Lt. Coltiletti served as a Personnel Officer in the Asiatic and Pacific theaters, where he was stationed at various airfields in Manila and Tokyo.

Previous to entering the service, he had been Assistant to the Secretary of the Institute.

Sgt. Hugh C. Judge, who recently returned from the European theater after more than 3 years' service with the U.S. Army Air Forces, has rejoined the Institute staff as an Assistant to the Manager of the AERONAUTICAL ENGINEERING REVIEW and AERONAUTICAL ENGINEERING CATALOG.

Sgt. Judge served as an Ordnance Specialist with the 8th Air Force, and with the 9th Air Force in the Flying Control Section at the European Air Depot, Erding, Germany.

Before entering the armed service, he had been Production Assistant and Secretary to the Manager of the AERONAUTICAL ENGINEERING REVIEW.

M.A.A. Elects Officers

The Manufacturers Aircraft Association, Inc., held an election of officers at its annual meeting on January 29. Members of the Institute elected to offices in the Association were: Chairman of the Board, S. S. Bradley; General Manager, John A. Sanborn; Vice-Presidents, Robert E. Gross, J. H. Kindelberger, William E. Valk, Jr., and Raycroft Walsh. Mr. Valk was also elected to the Board of Directors. Other Institute members elected to the Board were: Clayton J. Brukner, Alexander T. Burton, Charles H. Chatfield, and W. Wallace Kellett.

Gifts to the Aeronautical Archives

Mr. and Mrs. Gordon Wightman gave seven gliding trophies won by their son, Henry Nicoll Wightman, in his memory. A trophy, presented by the Central Aviation School to the American Aviation Mission to China in 1935 as a token of their service, was loaned by Col. John H. Jouett.

Col. Carl R. Borkland gave 20 models reproducing aircraft that were landmarks in the history of aviation, from

HANGAR FLYING

LOCKHEED

PILOT-BOOSTER

Few people know that at one curious stage in the development of the *Constellation*, the plane's hydraulic booster system worked *too* well.

The plane was designed so that the boosters, instead of the pilot, would do most of the work moving the control surfaces. For every pound of push the pilot puts on the rudder pedals, for instance, the booster now exerts 23 pounds of pressure to move the rudder. Saves the pilot a lot of wrestling. And assures really full control of big, modern four-engine airliners.

Well anyway, early in the game Lockheed perfected the booster system to such a point that you could practically fly the *Constellation* with your little finger. This reaction, of course, was too sensitive for general use... but the point is that the all-important "feel" of the ship has been tailor-made to the exacting wishes of experienced pilots, who swear by it.

Now, to passengers and pilots, the *Constellation* acts like the thoroughbred she is. Her foolproof booster system (the only one with a C. A. A. approved type certificate) makes the 45-ton, four-engine plane handle as lightly as a twin motor job.

Like everything else on this ship, the boosters were developed by imaginative, painstaking engineering... the kind that keeps Lockheed leading the field.

L to L for L

© 1946, Lockheed Aircraft Corp., Burbank, Calif.

the Chinese top and Leonardo da Vinci's ornithopter to the Wright Brothers' biplane of 1903. A Japanese bomb-timing device was sent by Alfred Marchev. The British Air Commission added 16 *R.T.P. Translations* to the large number previously given.

The Curtiss-Wright Corporation sent approximately 9,000 issues of periodicals. Periodicals were also received from Aero Insurance Underwriters, Inc., *Aviation*, and Fairchild Engine & Airplane Corporation. Dr. Alexander Klemin added pamphlets and periodicals to his previous generous gifts.

Documents concerning proceedings before the Civil Aeronautics Board relating to new air routes and extensions of existing routes were received from Eastern Air Lines, Inc.; Pan American Airways, Inc.; Parks Air Transport, Inc.; Transcontinental & Western Air, Inc.; and United Air Lines, Inc.

Additional gifts were received from Edward S. Evans Transportation Research, New York State Bureau of Aviation, U.S. Bureau of Naval Personnel; Civil Aeronautics Administration, Civil Aeronautics Board, Department of State, National Bureau of Standards, War Department, and the House and Senate Document Rooms.

Corporate Member Expands

The Ryan Aeronautical Company has announced the creation of a new division, The Stainless Steel Manufacturing Division, for the production of both aircraft accessories and nonaeronautical stainless-steel products.

The principal products of the new division are aircraft exhaust systems, parts for jet-propulsion engines, and allied accessories, which are already in production. In addition, new products of stainless steel which fit the facilities and technique of this division have been developed. It was created to accommodate the company's broadening line of products.

Sections and Branches

Buffalo Section

Benson Hamlin, Flight Research Engineer at Bell Aircraft Corporation, presided over a meeting of the Buffalo Section held on January 24 in the Statler Hotel, Buffalo. Mr. Hamlin was appointed Section Chairman by the Advisory Committee to replace E. E. Foster, who has left the area. Paul Hovgaard, Associate Director of the Cornell Aeronautical Laboratories, and D. Roy Shoults, Vice-President of Engineering, Bell Aircraft Corporation, were installed at this meeting as members of the Advisory Committee.

Lawrence D. Bell, President of Bell Aircraft Corporation, introduced the principal speaker, Alfred Marchev, President of Republic Aviation Corporation, who addressed the group on "Simplified Design for Low Cost Airplanes." The talk covered the design problems that must be solved to achieve lower-cost production. Mr. Marchev stated that simplified airplane design principles apply equally well to helicopter production. He stressed the importance of designing the product to meet requirements and specifications, then tooling up for its production, always keeping the number of machine tools at a minimum. He also emphasized that design should be directed toward a minimum of castings and extrusions, and a maximum of sheet-metal fabrication. Cost estimates should be based upon the efforts of specially qualified personnel who know how to plan, set up methods, and design according to end-result requirements. Sound judgment must be exercised in deciding whether it is cheaper to build a part or buy it elsewhere.

At the next meeting, Richard Frost, Project Engineer and Test Pilot, Bell Aircraft Corporation, will speak on "Radio-Controlled Flight-Testing of Fighter Aircraft."

Detroit Section

At a meeting held on January 10 in the Horace H. Rackham Educational Memorial Building, Chairman Arthur A. Locke called attention to the Light Plane Meeting, tentatively scheduled for April 25–26, to be held in Detroit, and invited members to submit outlines of papers to the Meetings Committee of the Institute for consideration for the program. The principal speaker at the meeting was Raymond F. Ternes, Patent Attorney of the U.S. Rubber Company, whose subject was "Patents and Aircraft."

In his talk Mr. Ternes gave an explanation of patents, with particular emphasis on what an engineer should know about patents in order to protect his inventions and to enable him to cooperate understandingly with his patent attorney. He also outlined the desirable methods of protecting inventions prior to filing patent applications.

The protection of aircraft inventions was analyzed from the standpoint of both design and utility patents. Helicopter patents were discussed particularly. A brief history of the origin of the helicopter was given, with a survey of some of the earlier patents, which, according to Mr. Ternes, were to a large extent based on imagination rather than on sound engineering. The speaker also pointed out how fictitious patents have prevented the securing of later ones which had a sound engineering basis.

At the next meeting, A. R. Fontaine will speak on the "Bendix Two-Place All-Metal Plane."

Los Angeles Section

A meeting of the Advisory-Management Committee was held on January 3 in the Hollywood-Roosevelt Hotel, presided over by Clarence L. Johnson, Section Chairman. The duties and responsibilities of the Committee were outlined, followed by a discussion of the proposed Section building. Building plans and cost estimates were submitted and required procedure for obtaining actual building authorization was reviewed.

The Pacific Aeronautical Library was discussed, with particular emphasis on obtaining long-range commitments from the companies now supporting it. At present these companies are committed for 6-month periods. The suggestion was made that the Library send out a letter to carefully selected West Coast concerns, offering them the Magazine Index service of the Library. This might obtain a sizable number of subscribers and could relieve the contributors to the support of the Library of the heavy load they are now carrying. A discussion of the overall operating budget of the Section followed.

Miami Section

On January 23 a meeting was held at the Eastern Air Lines Maintenance School, under the chairmanship of B. C. Stephens. The Pan American Airways Dinner Key Terminal was designated as the new meeting place. It was decided that the Meetings and Papers Committee would inaugurate the practice of having individual Section members present papers on any new subjects for which they are qualified and which would be interesting to others. The use of films for illustration will be adopted at technical meetings. R. L. Jacoby, Junior Engineer of Pan American Airways System, spoke on the subject "Gasoline Aircraft Heaters and Heating Systems," and J. F. Burridge, Air-line Engineer, Hamilton Standard Propellers Division of United Aircraft Corporation, gave a talk on "Hamilton Standard Reversible-Pitch Propellers and Automatic Synchronizers."

In his lecture Mr. Jacoby used diagrams of the C-54 Janitrol Heater as basic examples. He stated that proper and adequate heating systems are becoming increasingly important as the later transports are developed for high-altitude flying. According to Mr. Jacoby, a weight-saving could be made by taking the cockpit heat from the main heater instead of using two separate systems. The desirability of installing some means of preventing the temperature from fluctuating between hot and cold because of thermostatic action was discussed, and several ideas were suggested to accomplish this end.

Mr. Burridge gave a brief description of the cam design of the new reversible-pitch propellers which are used as brakes when the aircraft is landing. The consequences of reversing them while in flight were readily seen. The speaker stated that another major function of these propellers lies in taxiing the plane, explaining that both taxiing and landing save the brakes to such an extent that the overhaul periods may be greatly extended. Safety features incorporated in the dome prevent the propeller from going into reverse because of its own inertia. Control quadrants are also being designed to incorporate the reversing feature by having a spring-loaded offset through which the control lever would have to be pulled to reverse the propellers. The offsets prevent the unconscious reaction of pulling the propeller control lever on back into reverse instead of feathering. Mr. Burridge then explained the function and use of the automatic synchronizer, which uses one engine as a leader and the others as "slave" engines. Mechanical switches are installed so that any or all engines may be taken away from the automatic unit. If the lead engine fails, the next slave engine becomes the lead engine, and so on down the line.

Philadelphia Section

A January 15 committee meeting specifically outlined the duties and responsibilities of the various committees. It was decided that all Committee Chairmen shall submit a written report to the Section Chairman on the first of each month as to the activities of their respective committees. It was also decided that the Area Councilor from Philadelphia shall make two trips to the Institute's headquarters in New York each year. The suggestion was offered that business meetings immediately preceding the monthly technical meetings of the Section be terminated as early as possible so as to provide ample time for the presentation and discussion of technical papers. It was proposed that the universities in the Philadelphia area be contacted in an effort to attract aeronautical engineering students to Section meetings.

A technical meeting held on January 22 at The Engineers Club of Philadelphia was presided over by F. G. Tatnall, Philadelphia Section Chairman. Thomas D. Perry of the Resinous Products and Chemical Company presented his paper titled "Adhesives and Their Application." The speaker discussed conventional adhesives and resinous adhesives; wood-to-wood, wood-to-metal, and metal-to-metal applications; fabrication methods; evaluation of joints, and similar topics with particular reference to aircraft.

At the next meeting, Capt. R. S. Barnaby, U.S.N., will present a paper on "Gliding and Towed Flight."

San Diego Section

On January 18 a meeting of the San Diego Section was held as a dinner meeting in the San Diego Club. Jack Mason, Section Chairman, informed the members that the plans for the new Section building were being completed and that arrangements for a building site had been effected through the Board of Directors of the Consolidated Vultee Aircraft Corporation. He revealed that bids for the construction of the building would soon be let and expressed hopes that construction would be completed this year. Chairman Mason also rendered acknowledgment to Major R. H. Fleet, Past-President of the Institute, who was among those present, for his fine work in initiating the national plan for section buildings, as well as for his efforts in raising the funds for the San Diego Section building.

Charles Blake then assumed chairmanship of the meeting for the technical session. He introduced Dr. Norton B. Moore, Manager of Research at the Aerojet Engineering Corporation, who presented his paper titled "Atomic Rockets." Although restricted in the nature of the material which he could present, Dr. Moore told of the different types of propulsion units which are under study today, which include in addition to the internal-combustion engine, solid and liquid jets, gas turbines, rockets, athodyds, and atomic engines. He discussed the units by which thrust from these sources are measured, the amount of thrust which thus far has been obtained, and the amount that can be seen in the near future. The speaker also dealt with the amount of thrust that would be necessary if interspace travel is to become a reality. At the conclusion of his address, Dr. Moore presented the motion picture *Flight Test of the Me-163 Rocket Interceptor*, which is believed to be the only existing copy of a captured German film.

Ernest G. Stout, Design Specialist in Charge of Hydrodynamics, Consolidated Vultee Aircraft Corporation, and Albert A. Arnhym, Consulting Engineer, Solar Aircraft Company, presented sidelights on the difficulties that they had encountered in flight-testing the Me 163 during their search for engineering information inside Germany.

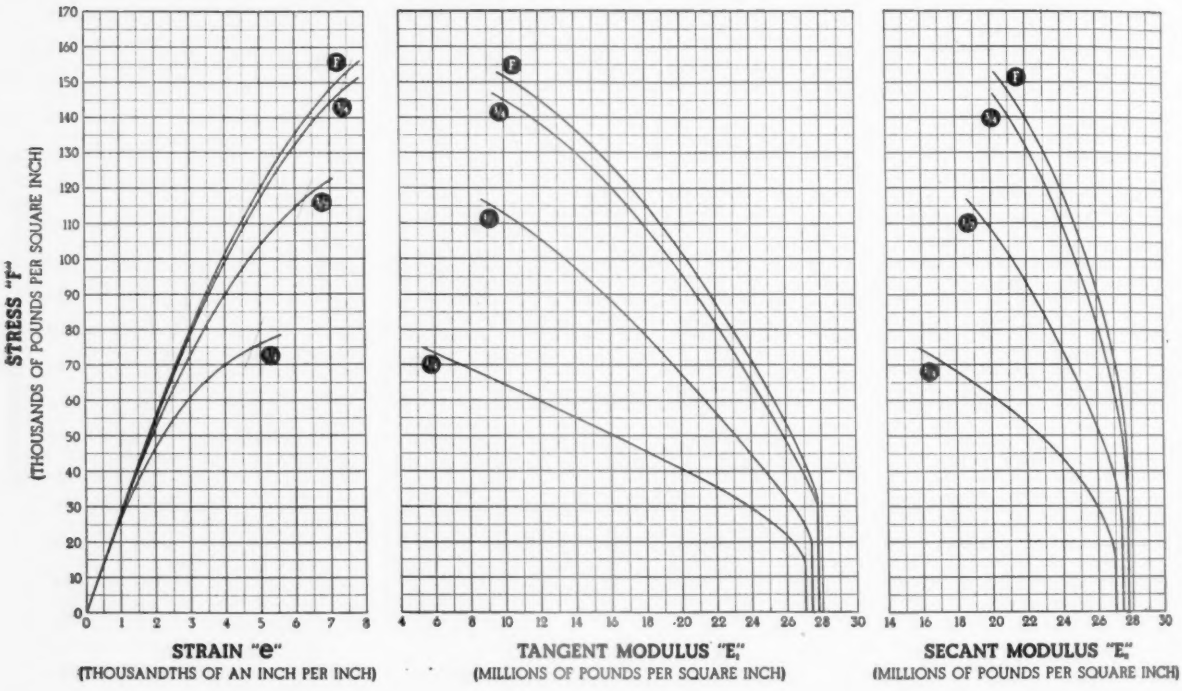
Washington Section

On January 9 a meeting was held in the U.S. Chamber of Commerce Auditorium at which R. P. Kroon, Manager of Engineering of the Aviation Gas Turbine Division, Westinghouse Electric Corporation, addressed the Section on "Jet Propulsion." Mr. Kroon discussed gas-turbine development in general and the "Yankee" aircraft turbine in particular. A full-sized cutaway model of the "Yankee" turbine was used for pertinent illustrative purposes. A discussion period followed Mr. Kroon's address.

Newly released pictures from the Navy Department showed the McDonnell Phantom, twin jet-propelled fighter aircraft.

IF YOU ARE A DESIGN ENGINEER

THIS BOOK IS A "MUST"


STRESS "f"
(THOUSANDS OF POUNDS PER SQUARE INCH)
STRAIN "e"
(THOUSANDTHS OF AN INCH PER INCH)
TANGENT MODULUS "Et"
(MILLIONS OF POUNDS PER SQUARE INCH)
SECANT MODULUS "Es"
(MILLIONS OF POUNDS PER SQUARE INCH)

These curves show the tensile properties of ARMCO High Tensile Stainless Steel Sheets from tests made on longitudinal specimens as cold rolled. They are reproduced from a practical new handbook that contains compression and tension values of high strength stainless for the complete useful range.

These data give the stress-analyst and designer the information needed to proportion stronger, lighter structural parts with *less* stainless. Construction of aircraft and other light-weight structures demands adequate knowledge of the compressive strengths that can be expected from the materials you use.

Besides the detailed values for stainless, the handbook covers some fundamental concepts of design theory to be considered when using stainless steels at the high stress levels where they are most effective. Mechanical properties of the stainless steels and derived design data are also included in the book.

		¼ Hard	½ Hard	¾ Hard	Full Hard
Ultimate Strength—thousands of lb. per sq. in.	F_{tu}	133	162	183	187
Yield Strength at 0.2% Offset—thousands of lb. per sq. in.	F_{ty}	75	117	147	153
Proportional Limit at 0.01% Offset—thousands of lb. per sq. in.	F_{tp}	35	49	59	61
Initial Modulus of Elasticity—millions of lb. per sq. in.	E_o	27.0	27.5	28.0	28.0
Elongation—per cent in 2 in.		46	37	31	29

If you are a designer of light-weight structures, write us on your company letterhead for a free copy of this handbook. It is titled: "Design Data on High Tensile Stainless Steel Sheets for Structural Purposes." You'll find it a valuable addition to your design manuals. The American Rolling Mill Company, 531 Curtis St., Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

STAINLESS ARMCO STEEL

THE AMERICAN ROLLING MILL COMPANY

Wichita Section

A dinner meeting was held on January 8 in the Drolls Dining Room. Kenneth Razak, Section Vice-Chairman, presided.

The principal speaker was Zell G. Herman, of the Public Relations Office at Beech Aircraft Corporation, who spoke on "Radar Development in World War II."

Mr. Herman discussed the development of radar and the use to which it had been put during the war. He also spoke about the possible uses of radar in peacetime, especially as an aid to airway navigation.

Academy of Aeronautics

At a business meeting held on December 2, motions were passed for the amendment of the Constitution and the addition of a new committee, the Technical Committee. Edwin Siekierski, Chairman of the Social Committee, read his report, after which plans were discussed for future social events. Thomas J. Knust, Branch Chairman, presided.

On December 10 a business meeting was held at which Albert Demchak, Branch Treasurer, submitted his report. Secretary Adolfo Munoz informed the members about the New York Section meeting to be held that evening in the McGraw-Hill Building.

At the January 7 meeting, reports were submitted by the Treasurer and the Chairman of the Executive Committee. Margaret Liebhauser, Chairman of the Papers Committee, enlisted volunteer typists and artists to work for the school newspaper.

Frank A. Tedesco, Branch Vice-Chairman, presided over a business meeting on January 14, at which a motion was unanimously passed to conduct a raffle in order to improve the financial position of the Branch. Further discussion of this motion took place at a meeting on February 1, Adolfo Munoz presiding.

Aeronautical University

At a meeting which took place on November 28, presided over by Chairman Raymond B. Williams, there was a discussion of ways in which better application could be made of the material acquired in the various courses.

On December 12, the film *Better Planes for Tomorrow* was shown, and on December 19 the Moving-Picture Committee made its annual report.

William Mleczko, Branch Vice-Chairman, presided over a business meeting held on January 9. The minutes of the previous meeting were read and approved, and the Speakers Committee submitted its report.

Alabama Polytechnic Institute

The Student Branch of the Alabama Polytechnic Institute has been reactivated, with Prof. Robert G. Pitts as Faculty Adviser.

University of Alabama

The film *The Bell Helicopter* was shown at a technical meeting held on January 14 in the Engineering Building, under the chairmanship of William K. Rey.

On January 28, Earl W. Karm spoke on the subject "Development of Jet Propulsion."

The Catholic University of America

On January 15 a combined technical and business meeting was held under the chairmanship of Michael J. Quirk. The principal speaker was Lt. James Beach, U.S.N., an alumnus of the University, whose subject was "History of a Military Airplane from Conception to Use by the Fleet." A 45-min. discussion period followed the address. The main points covered were jet engines as related to the Navy; the use and value of the torque nose for measuring power delivered while in flight; value and operation of a full-feathering propeller; and what is expected of a newly graduated engineer. The films *Keep 'Em Flying* and *Wings of the Army* were shown.

Georgia School of Technology

At the January 10 meeting, Mr. Campbell, of the National Advisory Committee for Aeronautics, spoke on the subject "Experiments on Ice Prevention."

University of Illinois

On January 23 a combined technical and business meeting was conducted in the Engineering Hall under the chairmanship of Leland C. Schubert. Prof. H. S. Stillwell gave a talk titled "Aeronautical Engineering at the University of Illinois." Following this address, Chairman Schubert explained the purposes and functioning of the Institute and the benefits to be derived from Student Membership. Honorary Chairman Prof. R. W. McCloy then made further explanatory remarks as to the method by which Student Membership is obtained and the privileges of such membership.

At a business meeting held on January 30 in the Mechanical Engineering Laboratory, the Constitution of the Branch was ratified and the date of the next meeting was set.

Iowa State College

A technical meeting was held on December 5 in the Engineering Hall. A. Boreman, Chairman of the National Unscheduled Flight Advisory Committee of the C.A.A., spoke on "The Future of Private Flying." Mr. Boreman noted that interest in private flying is on the increase, especially among farmers. He stated that the greatest demand for light planes will be from farmers in the Middle West, at least for the next few years.

At a meeting held on January 17 in the Memorial Union, C. Sanford and E.

I.A.S.

National Meeting Schedule

1946

AIRCRAFT PROPULSION

March 21–22 — The Cleveland Club, Cleveland, Ohio

LIGHT AIRCRAFT

June 13–14 — Rackham Educational Memorial, Detroit, Mich.

ANNUAL SUMMER MEETING

August — Los Angeles, Calif.

AIR TRANSPORT

October — Hotel Statler, Washington, D.C.

WRIGHT BROTHERS LECTURE

December 17 — New York, N.Y.

Secret Life of an Aircraft Designer

Most of us do our heavy thinking about something that's already happened or that's going to happen soon. Not so with an aircraft designer. He's made something happen a couple of years up the line . . . an ideal of flight . . . and what's wrinkling his brow is how to get back with it and not lose too much on the way.

By going the way they're going, thinking right along with them, Fafnir made themselves useful to aircraft designers. It's one of the reasons Fafnir furnishes the aircraft industry more ball bearings than all other bearing manufacturers.

The new Ryan Fireball fighter plane is a case in point. A few years ago it was just lines on a designer's forehead. Now it's a U. S. Navy approved super fighter for carrier-based operations. Ryan got substantial help from Fafnir in cancelling out friction, handling super-speeds and cutting down weight and maintenance. Obviously, such a plane takes a lot of controls, very exacting controls, Fafnir-equipped controls.

Bearings for a job like this are not just ordered out of a catalog. They come out of an intimate collaboration . . . the kind that's made Fafnir the largest supplier of ball bearings to the aircraft industry. The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR

BALL BEARINGS

For Aircraft

Sorenson spoke on "The B-29, Design and Combat Flight." Mr. Sanford discussed the design of the B-29 and cited many examples of problems that had to be solved before the successful design was completed. Mr. Sorenson's talk was concerned with the actual combat problems met in his many flights over Japan as a member of the crew of one of the B-29's that first flew nonstop from Japan to Washington, D.C.

University of Kansas

At a technical meeting held on January 8, Russell B. Hays spoke on the subject "Development of Helicopter Rotors." Vice-Chairman Roy McVey presided.

Massachusetts Institute of Technology

At a meeting held on January 9, Prof. Otto C. Koppen of the Aeronautical Engineering Department at the University gave a talk titled "Johnny Jones and His Broken-Down Airplane." Professor Koppen pointed out that the original light-plane buyers are usually city dwellers, who think of an airplane as a plaything. In a year or so they are dissatisfied with the inconvenience inherent in outlying airfields and high operating expenses. Accordingly, they put their planes on the secondhand market. The next buyers are usually rural people whose backyards are their airfields. Professor Koppen suggested and sketched his idea of a roadable plane that would offset the disadvantages of airport distances and bad weather restrictions. This plane will have folding wings and a removable propeller. The speaker stated that, contrary to popular opinion, these roadable qualities would not affect its flight characteristics. He then went on to give a general picture of probable future development in private flying.

North Carolina State College

At a technical meeting on December 4, conducted by Chairman C. E. Grigsby, the films *The PT-19* and *The AT-21* were shown.

At a business meeting held on December 18, Harry Snavely was elected Treasurer for the coming year.

On January 22 a technical meeting was held, at which Dr. J. W. Cell spoke on the subject "Conformal Mapping."

University of Notre Dame

The film *Keep 'Em Flying* was shown at a meeting on November 23. Of particular interest in this film was the illustration of the functioning of the hydromatic-type propeller.

On December 6 a meeting was held at which John Parchem, Instructor in the Aeronautical Engineering Department of the University, was the principal speaker.

At a meeting held on January 11, Dr. James F. Reagan, Associate Professor of Aeronautics at the University, addressed the Branch on the subject "Parachutes."

The following officers were elected for the new semester: Chairman, Michael J. Mack; Vice-Chairman, Richard Kirk; Secretary, Robert M. Snyder; Treasurer, John H. Huntzicker. R. S. Eikenberry is Faculty Adviser.

Princeton University

The Student Branch of the Institute at Princeton University has been reactivated. Courtland D. Perkins is Faculty Adviser.

Spartan College of Aeronautical Engineering

At a meeting held on January 16, Estil Sherril spoke briefly to the new members about the benefits to be derived from membership in the Institute. He then answered questions from the floor.

M. D. Saslaw is now Faculty Adviser, replacing Robert Mann.

University of Texas

A combined business and technical meeting took place on January 22, conducted by Chairman B. A. Chaudoin. The Faculty Adviser, W. A. Meyers, addressed the group on the functions and responsibilities of the Student Branch.

The film *Fight For the Skies* was shown. It was decided that the election of officers be postponed until registration for the Spring semester has been completed.

An informal smoker was held on February 5, at which motion pictures were shown.

Tri-State College

The first meeting of the new term was held on January 28, under the chairmanship of Walter Remy. Membership cards were filled out and the business details of beginning a new season were completed.

University of Tulsa

On January 10 a Technical Meeting was held in the Phillips Engineering Building under the chairmanship of Adolf E. Kowalski. W. A. Romine, of the Spartan Aircraft Company, spoke on the subject "The Future for Aeronautical Engineers." The film *Wright Builds for Air Supremacy* was shown.

Virginia Polytechnic Institute

A meeting was held on January 8 in Patton Hall, under the chairmanship of F. B. Sutton, who outlined the program for the coming quarter. Prof. L. Z. Seltzer gave a talk in connection with the orientation of new members of the Branch. The films *Duramold Process Used on AT-21* and *Flight Log of Fuels* were shown.

At a meeting held on January 22, E. P. Luke, formerly an Engineering Officer of the U.S. Army Air Forces, spoke on the subject "Exploitation of the German Air Force by the AAF." Plans were discussed for obtaining permission to visit the N.A.C.A. laboratories at Langley Field and the Air Technical Service Command facilities at Wright Field. The date of the Wright Field trip was tentatively set.

University of Washington

The following Officers of the University of Washington Student Branch were elected for the coming semester: Chairman, George M. Phelps; Vice-Chairman, Harold E. Froelich; Secretary-Treasurer, John T. Zachary. V. J. Martin is Faculty Adviser.

News of Members

William A. Anthony is now a Mechanical Engineer with the Gas Machinery Company.

Col. Allan A. Barrie has returned to Western Air Lines, Inc., as Special Assistant to the Vice-President in Charge of Operations.

Murray C. Beebe, Jr., has joined Fredric Flader, Inc., as an Engineer.

Gilbert C. Best is now a Stress Analyst at Republic Aviation Corporation.

Allan E. Bjerke has joined the Aircraft Division of the Cleveland Pneumatic Tool Company as Senior Engineer and Stress Analyst.

Ralph L. Blake is now a Designer at the El Segundo Division of the Douglas Aircraft Company, Inc.

Victor F. Boetel has become a Stress Analyst "A" for Northrop Aircraft, Inc.

Everard A. Bonney is now a Junior Engineer at Johns Hopkins University.

Gordon D. Brown has been elected a Vice-President of Bankers Trust Company.

Charles R. Carrier is now an Aerodynamicist at the El Segundo Division of the Douglas Aircraft Company, Inc.

Edward Cosbey, Jr., has become an Engineering Designer at Republic Aviation Corporation.

Donald K. Covington, Jr., has joined The Glenn L. Martin Company as Senior Flight Test Engineer.

Herbert E. Crumrine has been elected Vice-President of Product Technicians, Inc.

A TALE of a TAIL

Tail of a huge "Skymaster." Chicago and Southern's new "Skymasters" each will fly half a hundred passengers at 4 miles per minute.

A TALE goes with the tail shown here — an inspiring story of the skyways. In 1933, as a newcomer, Chicago and Southern Air Lines entered the transportation field. *Today* as the major Gulf-to-Great Lakes commercial air line, Chicago and Southern can measure its air service in terms of millions —

23,860,000 revenue miles flown
2,137,850,000 pound miles of express flown
4,450,000,000 pound miles of mail flown

May 1, 1946 brings a new fleet of super-luxurious DC-4 "Skymasters" to supplement the service of the "Dixieliners" that flew the millions mentioned here.

Sinclair is proud to have a place in the story. Chicago and Southern in '46, (as in previous years) relies on Sinclair Pennsylvania Aircraft Engine Oil for lubrication of its ships.

SINCLAIR AVIATION OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

Jacob P. Den Hartog has returned from active duty with the U.S. Navy, in which he held the rank of Commander. He has joined the Faculty of the Massachusetts Institute of Technology as Professor of Mechanical Engineering.

Jean H. DuBuque is now Sales Consultant at Beech Aircraft Corporation.

A. Felix du Pont, Jr., has been elected a Director of All American Aviation, Inc.

John O. Emmerson is now a Stress Engineer with Canadair Limited.

Duane W. Farnham has joined the Manufacturing Department of Stanolind Oil & Gas Company.

William S. Farren, formerly Director of the Royal Aircraft Establishment, has been released from the service of the British Government and has been appointed Technical Director of Blackburn Aircraft Limited.

Delbert J. Forward is now an Engineer with the Laminated Process Company.

Arthur P. Fraas has joined the Faculty of the Case School of Applied Science as Assistant Professor of Automotive Engineering.

Maurice A. Garbell, who carried out confidential work in aerodynamics with Consolidated Vultee Aircraft Corporation during the war, has established an office as Independent Consultant in Aeronautical Engineering and Meteorology.

Doane R. Gero has joined the Cleveland Pneumatic Tool Company as Stress Engineer.

Richard V. Glenn is now a partner in Glenn's Pharmacy.

Rolf F. Goranson has become a Flight Analyst with the Civil Aeronautics Administration.

John J. Green, who served during the war as Chief Technical Officer at the Test and Development Establishment of a Royal Canadian Air Force station, has become Chief Research Aeronautical Engineer of the Air Transport Board (Canada).

Walter M. Hartung has terminated his service with the Air Transport Command, A.A.F., in which he was a Lieutenant Colonel, and has returned to the Academy of Aeronautics, Inc., as Vice-President and Executive Director.

John R. Hoyt has returned from active duty with the U.S. Navy, in which he held the rank of Commander, and has become Chief of the Schools and Training Section, Airman Division of the Civil Aeronautics Administration.

Dean G. Klampe is now a Seaman 1/C in the U.S. Naval Reserve.

Walter L. Koch has joined North American Aviation, Inc., as an Aerodynamics Engineer.

Vice Admiral Emory S. Land has received President Truman's acceptance of his resignation as Chairman of the U.S. Maritime Commission. Admiral Land will assume the Presidency of the Air Transport Association.

Francis D. Matthews has become an Instructor at the Educational Service Division of United Air Lines.

Wayne F. Miller has joined the Engineering Department of Laister-Kauffmann Aircraft & Glider Corporation as Specifications Supervisor.

Penn E. Mullowney is now Assistant Design Engineer at The Glenn L. Martin Company.

Clinton T. Newby has joined the El Segundo Division of the Douglas Aircraft Company, Inc., as Stress Analyst.

Irving B. Osofsky is now a Research Assistant and Graduate Student at Rensselaer Polytechnic Institute.

Bruce H. Pauly has joined the Aviation Gas Turbine Division of Westinghouse Electric Corporation as Design Engineer.

Courtland D. Perkins has become Associate Professor of Aeronautical Engineering at Princeton University.

Eldo A. Peterman has returned from military service, in which he was a Colonel in the Air Technical Service Command at Wright Field, and has joined Lockheed Aircraft Corporation as Staff Engineer.

Eric Reissner, Assistant Professor of Mathematics at Massachusetts Institute of Technology, has been appointed Managing Editor of the *Journal of Mathematics and Physics*, an M.I.T. publication devoted to the mathematics of engineering and physics.

David A. Richardson is now a Design Engineer at the Kellett Aircraft Corporation.

David F. Robertson has become a Structures Engineer at the Globe Aircraft Corporation.

George E. Robinson is now Chief Test Engineer at the Bomb Laboratory of the Massachusetts Institute of Technology.

Arthur E. Rowland has joined the Southern Aircraft Corporation as Structures Engineer.

Jesse J. Steinman is now a Structural Designer with the firm of A. C. Martin.

Blaine K. Stevens is now a Project Engineer at Lear, Incorporated.

Milton J. Thompson is now Chairman and Professor of the Department of Aeronautical Engineering at the University of Texas. He is also Associate Director of the University.

Francis L. Thornburg has become a Designer at the Auburn Manufacturing Company.

Ray G. Trout is now a Research Engineer with Aeronca Aircraft Corporation.

Nathan F. Vanderlipp has joined Kellett Aircraft Corporation as Works Manager.

Harvey L. Williams has been elected Executive Vice-President of Chicago and Southern Air Lines, Inc.

Donald P. Wilson has been appointed Aviation Sales Manager of the Federal Telephone and Radio Corporation.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Blanck, George Melville, Liaison Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Dickinson, Holley Buckingham, M.S.; Flight Test Supervisor, Lockheed Aircraft Corp.

Gregory, Hollingsworth Franklin, A.B.; Col., U.S. Army Air Forces.

Irwin, Arthur Samuel, B.S.; Sr. Development Engineer, Bell Aircraft Corp.

Shue, George Llewellyn, Ph.D.; Aerodynamics Engineer, Consolidated Vultee Aircraft Corp.

Smithline, Lawrence Nathaniel, M.S. in Ae.E.; Asst. Executive Engineer—Manager, Plastics Div., York Research Corp.

Stieglitz, William Irving, S.B. in Ae.E.; Design Engineer, Republic Aviation Corp.

Terry, Cyrl Waldie, M.M.E.; Associate Prof.—Aeronautical Engineering Dept., Cornell University.

Vielle, Eugene Emile, Group Capt., Liaison Officer, Royal Air Force (England).

Elected to MEMBER Grade

Adams, James Wendell, C.E.; Associate-Consulting Engineer and Chief Engineer—Airports Div., McLaughlin-Carr Associates.

Anderson, Frederick Wilbur, B.S. in Ae.E.; Structures Engineer, Boeing Aircraft Co.

Berry, Frederic Aroyce, Jr., B.S.; Capt., U.S. Navy.

Brown, Joseph, B.S. in M.E.; Mechanical Engineer, Naval Aircraft Factory, Philadelphia Navy Yard.

Carlson, Francis Bernard, B.Ae.E.; Lt. Col., U.S. Army Air Forces.

Doty, Louis Francis, B.S. in Ae.E.; Instructor, University of Cincinnati.

Flower, Scott, M.E.E.; Capt., Asst. Chief Pilot Technical, Pan American Airways System.

Frankenfield, Charles Walter, M.S.; Supervisor, Tide Water Associated Oil Co.

Frederick, Carl Leroy, M.A.; Chief, Physics Dept., Cornell Aeronautical Lab.

Gasper, Joseph James, B.S.M.E.; Lt. (j.g.), Assembly and Repair Officer, U.S. Navy.

Gureev, Dmitrii Iosifovich, M.Ae.E.;

100,000 R.P.M.

Midget 3 lb. Turbine Cools Air 140° F.

Operating speeds in excess of 100,000 R.P.M. create air velocities up to 800 miles per hour in the new midget 3 lb. AiResearch Expansion Refrigeration Turbine, which is revolutionizing the aircraft airconditioning field.

This turbine—weighing only one-fiftieth as much as a conventional refrigeration system of similar capacity—makes possible *high speed, pressurized* flight by post-war commercial and military aircraft, because streamlining necessary to reach today's speeds leaves no room for ordinary electrical cooling equipment.

It uses only air as a refrigerating medium, and it requires no additional source of power. It has a *single moving* part...and is the only mechanical unit with a self-contained lubrication system ever to operate at such high rotative speed in a fully maneuverable airplane.

Produced after nearly five years of engineering research, the midget cooling turbine is another AiResearch "first".

AiResearch cooling turbines—ranging from the 3 lb. midget up to more powerful slower speed units approximately 18 inches in diameter—are being built for such planes as the Lockheed Constellation and P-80; Douglas DC-6 and B-43; Consolidated Vultee P-81 and B-46; North American B-45 and Boeing C-97. The AiResearch background of engineering skill and research is available to help solve *your* Air Control problems. Write to AiResearch Manufacturing Company, Los Angeles 45, California.

AiResearch — manufacturers of AIR CONTROL equipment • Cabin Pressure Regulating Systems • Engine Oil Cooling Systems • Supercharger Aftercooling Systems • Temperature Control Systems • Engine Intercooling Systems • Automatic Exit Flap Control Systems

AiResearch
DIVISION OF
THE GARRETT CORPORATION

Lt. Col., Sr. Engineer, Soviet Government Purchasing Commission.

Haines, John Fenimore, M.S. in Ae.E.; Asst. Chief Engineer, Aeroproducts Div., General Motors Corp.

Hall, Robert Thomas, B.S. in Ae.E.; Field Engineer, Thompson Products, Inc.

Herrick, Thomas Jefferson, M.S.; Asst. Prof. of Aeronautical Engineering, Purdue University.

Kelly, Raymond Douglas, B.S. in M.E.; Supt. of Engineering Development, United Air Lines, Inc.

Liepmann, Hans Wolfgang, Ph.D.; Research Fellow, California Institute of Technology.

McGough, Wilson Newton, B.Ae.E.; Aerodynamicist, North American Aviation, Inc.

Marks, Paul Newell, Registrar, The Aeronautical University, Inc.

Martin, Lance Eugene, M.E.; Vice-President, W K Mfg. Corp.

Miller, David Chauncey, Cartographer, Tech. Asst. to Chief, U.S. Coast and Geodetic Survey.

Mitchell, John Lewis, Asst. Air Attaché, British Embassy (Washington, D.C.).

Pomeroy, Ralph Gaisford, Chief Technical Engineer, Vacuum Oil Co. of South Africa, Ltd. (South Africa).

Price, Clifford John, B.Sc.; Head of Aeronautics Dept., Pretoria Technical College (South Africa).

Rees, Howard Sutherland, B.Sc.; Research Aeronautical Engineer, Canadian Air Transport Board (Canada).

Richardson, Eri Horner, Jr., A.B.; Major—Chief Flight Projects Div., U.S. Army Air Forces (Reserve).

Richardson, Iden Foster, Jr., B.S. in M.E.; Asst. Sales Engineer, Bendix Products Div., Bendix Aviation Corp.

Romick, Darrell Carney, B.S.; Chief Engineer, Taylorcraft Aviation Corp.

Scherberg, M. G., Ph.D.; Research Engineer, McDonnell Aircraft Corp.

Smith, Neil Angus, Lt. Comdr., Asst. Director of Aircraft Maintenance & Repair, Royal Navy, (Washington, D.C.).

Valazza, Dino George, Flight Engineer, Transcontinental & Western Air, Inc.

Waite, David Edward, Aircraft Service Engineer, General Tire & Rubber Co.

Wang, Chi-Teh, D.Sc.; Research Associate, Brown University.

Williams, Allen Craig, Lt. (A), Air Engineering Officer in the Air Arm of the Royal Navy (New Zealand).

Wright, William Robert, Jr., B.S. in M.E.; Engineer, Marine Manufacturing & Supply Co.

Yates, Donald Norton, M.Sc.; Col., Chief—Weather Service, U.S. Army Air Forces.

Transferred to MEMBER Grade

Coulston, Richard Morrison, B.S. in Ae.E.; Consolidated Vultee Aircraft Corp.

Curtis, Lloyd Graham, Designer "A," Consolidated Vultee Aircraft Corp.

Hanson, Hugh Lowell, B.Ae.E.; Asst. Head of Flight Test Section, Bureau of Aeronautics, U.S. Navy Dept.

Horning, Don Oury, A.B.; Research Analyst, Consolidated Vultee Aircraft Corp.

Houser, Jacque, M.S.; Asst. Group Engineer, Boeing Aircraft Co.

Jonas, Julius, Aerodynamics Engineer, Northrop Aircraft, Inc.

Kelso, Lester Grandville, B.S. in Ae.E.; United Airlines Transport Corp.

Kieckhefer, Thomas Fred, B.S. in Ae.E.; Lt. (j.g.), U.S.N.R.

Kiester, Harry, B.S. in M.E.; Aircraft Project Engineer, Pan American Airways System.

Lief, Milton, B.S. in Ae.E.; Chief Flight Test Engineer, Curtiss-Wright Corp.

Maxam, Frederick Austin, B.S. in Ae.E.; Head of Aerodynamics and Experimental Flight Test, Curtiss-Wright Corp.

Neffson, Ben A., C.E.; Sr. Stress Analyst, The Glenn L. Martin Co.

Parker, Garth, B.S.E.; Aerodynamicist, Douglas Aircraft Co., Inc.

Sorenson, Emil Leonard, M.S. in Ae.E.; Major, Chief—Test Engineering Section, Flight Test Div., U.S. Army Air Forces.

Sutton, John Ransome, U.S. Army Air Forces.

Vedral, Anton Frank, Chief Technical Inspector, U.S. Army Air Forces.

Von Glahn, Uwe Hans Dieter, B.Ae.E.; Aero. Engineer, Aircraft Engine Research Lab., N.A.C.A.

Elected to Industrial Member Grade

Shott, Ned Easley, LL.B.; Asst. to Publisher, The New York Times.

Elected to Technical Member Grade

Chiang, Chi-Sheng, B.S. in Ae.E.; Student, University of Michigan.

Churchill, John Russell, B.S.; Aviation Cadet, U.S. Army Air Forces.

Clark, Robert George, B.S.; Engineering Designer, The Glenn L. Martin Co.

Das, Subodh Chandra, B.E. in E.E.; Research Analyst, Aeronautical Engineering Dept., Indian Institute of Science (India).

Esselen, Gustavus John, III, Operations Engineer, Pan American Airways System.

Fadler, Lawrence Forrest, Jr., Electrical Design Group Supervisor, Lockheed Aircraft Corp.

Frank, Robert Herman, B.S.; Project Engineer, U.S. Navy.

Gewinner, George William, Ae.E.; Member of Maintenance Crew, U.S. Army Air Forces.

Han, Tse-Hwa, B.Ae.E.; Student, University of Michigan.

Hoffman, Daniel Gerard, Lt., Chief Tech. Data Digest Unit, Intelligence (T-2), Air Technical Service Command, U.S. Army Air Forces.

Lanzara, Albert, B.Ae.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

McClelland, Thomas Gilbert, Lt., Flight Test Project Pilot, Naval Air Test Center (Patuxent River, Md.).

Neace, John Forrest, Director of Ground School, Southwest Airways, Inc.

Provenzano, Salvatore Charles, B.Ae.E.; Jr. Stress Engineer, Republic Aviation Corp.

Rama Rao, Muthyala Venkata, B. of Eng.; Apprentice, Hindustan Aircraft Ltd. (India).

Russell, Rex Harley, B.S. in Chemical Engineering; Lt. (j.g.), U.S. Navy.

Sadoff, Melvin, B.Ae.E., B. Bus. Adm.; Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Schlukbier, Frank Cameron, Inspector, The Glenn L. Martin Co.

Transferred from Student to Technical Member

Brewer, Thomas Larche, B.S. in Ae.E.; U.S. Navy.

Burlage, Henry, Jr., B.Ae.E.; Instructor in Aero. Engineering, Rensselaer Polytechnic Institute.

Clementson, Gerhardt Christopher, M.S. in Ae.E.; Capt., Instructor, U.S. Army Air Forces.

Eskin, Irvin Maxwell, B.S. in Ae.E.; U.S. Navy.

Farr, John Wesley, B.S. in Ae.E.; 1st Lt., U.S. Army Air Forces.

Gready, Joseph Mercer, B.S. in M.E.; Ensign, U.S. Navy.

Holladay, Durand Allen, B.S. in Ae.E.; Ensign, U.S. Navy.

Kaufman, Warren Frederick, B.S. in Ae.E.; Ensign, U.S. Navy.

Lemon, Richard Frank, B.S.; Ensign, U.S. Navy.

Ross, Donald Boyson, B.S. in Ae.E.; Ensign, U.S. Navy.

Necrology

Harry Bateman

Harry Bateman, Professor of Aeronautics, Mathematics and Theoretical Physics, at California Institute of Technology, died on January 21, en route to New York where he was to receive his certificate of Fellowship in the Institute on January 28.

Professor Bateman was born in Manchester, England, on May 29, 1882. He attended Manchester Grammar School and Cambridge University, receiving the degrees of B.A. in 1903 and M.A. in 1906. He came to the United States in 1910 and took his Ph.D. at Johns Hopkins University in 1913. He had been a member of the faculty at California Institute of Technology since 1917.

The author of many standard higher mathematics texts, Professor Bateman was internationally known for his research in pure mathematics and received wide recognition for his work on the special theory of relativity. Among

this flexible metal hose resists . . .

HIGH TEMPERATURE
REPEATED FLEXING
HIGH PRESSURE
CORROSION
VIBRATION

The flexibility of rubber . . . **plus the all-'round stamina of Monel, Nickel and Inconel** . . . is yours when you use flexible metal hose made by Eclipse.

The hose carries steam, corrosive fluids and gases. In some of the smaller diameters, test pressures up to 3000 p.s.i. have been applied with safety. And, with Inconel flexible hose now being successfully produced experimentally, the temperature ceiling has been raised to 2000° F.

The tubing is absolutely leakproof, for it is really a seamless metal tube that has been compressed into a series of bellows-like corrugations.

With corrugations deep, parallel, and rounded at top and bottom, the tubing is highly flexible.

Diameters as small as ⅛" are available.

If you've been bothered by rubber or soft metal tubing that can't "take" it, investigate all-Monel, all-Nickel or all-Inconel flexible tubing. For more information, write the manufacturer: Metal Hose Dept., Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N.Y.

NICKEL INCO TRADE MARK **ALLOYS**

MONEL* • "K" MONEL* • "R" MONEL* • "KR" MONEL* • "S" MONEL* • INCONEL* • NICKEL • "L" NICKEL* • "Z" NICKEL*

*Reg. U.S. Pat. Off.

his published works are *Partial Differential Equations of Mathematical Physics, Diagrams of Airplane Stability, Stability of the Parachute and Helicopter, The Inertia Coefficients of an Airship in a Frictionless Fluid.* He was a joint author of the *Report on Hydrodynamics*, published by the National Research Council in 1932, and he was author of many other technical papers and articles.

Professor Bateman was also a member of the British Association for the Advancement of Science, and of several other British and American scientific societies, and a Fellow of the Royal Society of London.

Thomas Logan Jackson

Thomas Logan Jackson, a Technical Member of the Institute and Engineering Draftsman at Hughes Aircraft Company, died on November 2.

Born in San Francisco, Calif., on September 5, 1908, Mr. Jackson was educated in the San Francisco schools and the University of California, where he received the degree of Bachelor of Science in Mechanical Engineering in 1934. From 1935 to 1936, he was a Draftsman and Stress Analyst for W. A. Bethel, a California contracting firm. Later in 1936, he joined the National Park Service and was placed in charge of engineering at a C.C.C. camp. From 1937 to 1941, he was associated with the War Department as an Educational Director. He became a Procurement Inspector at the A.A.F. Matériel Center at Santa Monica, Calif., in December, 1941. Mr. Jackson joined the Hughes Aircraft Company in 1942.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Design Engineers, Stress Analysts, Layout and Draftsmen—Needed for development work on experimental military aircraft, as well as production engineering. Address inquiries to Curtiss-Wright Corporation, Airplane Division, Columbus 16, Ohio, Attention: R. C. Blaylock, Chief Engineer.

Research Engineer—Theoretical Aerodynamicist or Thermodynamicist with advanced degree to engage in research on certain high-speed developments. For details write Box 1-T, Richmond 2, Va.

Design Engineers; Draftsmen—Opportunities now exist for qualified design engineers and draftsmen for work on the new stratocruiser C-97 military transport and other new developments. Here is an opportunity to become associated with one of the world's leaders in aircraft design and production and to participate in the design of the aircraft of tomorrow. Write to the Engineering Department, Boeing Aircraft Company, Seattle 14, Wash.

Aerodynamicists and Thermodynamicists—Research minded and with good theoretical background, to engage in research work on high-speed and jet propulsion developments, advanced degrees preferred. Salary commensurate to qualifications. Replies will be held in strict confidence. Write, giving education and experience, to Cornell Aeronautical Laboratory, Buffalo 5, N.Y.

Aeronautical Engineering Professor to teach Airplane Design, Airplane Structure, and related subjects. Applicants required to have a degree in aeronautical engineering as well as practical experience in the field. Preference given to candidates having advanced degrees. Facilities now under construction and plans for future construction will provide ample opportunity for research, development, and consultation. Rank and salary will depend upon training and experience of applicant. In applying please give brief sketch of personal qualifications, education, and experience. Address reply to Prof. Robert M. Pinkerton, Department of Aeronautical Engineering, A. & M. College of Texas, College Station, Texas.

Notices listed in the Personnel Opportunities column will appear in two consecutive issues of the *Aeronautical Engineering Review*. If it is required that such notices be carried for a longer period, notification to that effect should be given the Secretary of the Institute.

Aircraft Engineers—Immediate, permanent openings for aircraft engineers with 5 years' experience in aerodynamics, structural design, and C.A.A. airworthiness requirements with Southern California aircraft manufacturer. Air-mail qualifications and recent photo to P.O. Box 29, Burbank, Calif.

Detail and Layout Engineers, Stress Analysts, Aerodynamicists, and Design Engineers—For development work and production engineering work in Engineering Division. Call in person or write to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Radio, Electronic and Telephone Engineers, Electronic and Mechanical Draftsmen—One of the largest manufacturers of a wide variety of electronic and communications equipment in the world is fully prepared and ready with an ambitious postwar program. Write to Personnel Manager, Federal Telephone & Radio Corp., 591 Broad Street, Newark, N.J.

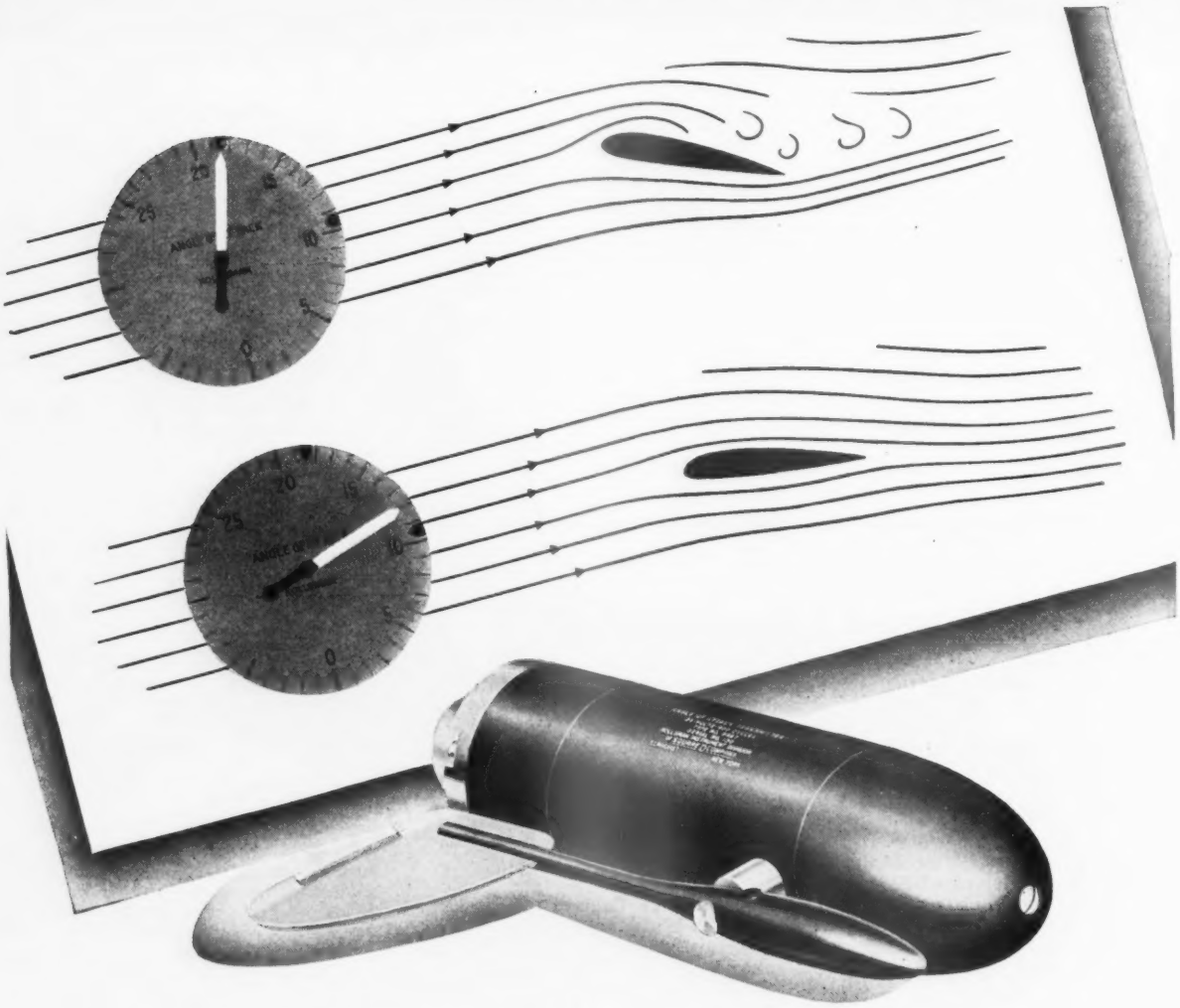
Aeronautical Engineer—To teach Senior year subjects of aeronautical engineering course including design and stress analysis. Address inquiries to The Aeronautical University, Inc., 116 South Michigan Avenue, Chicago, Ill.

Aircraft Stress Engineers thoroughly familiar with the analysis of aircraft structures, aircraft controls, and all component parts for work on helicopters. Excellent opportunities for personnel interested in rotary-wing aircraft. Apply by letter, giving references, to Administrative Engineer, Kellett Aircraft Corporation, Plant #2, Lansdowne Avenue above State Road, Upper Darby, Pa.

Personnel Needed—Executive and Administrative experience in manufacture of aircraft. Positions available in several fields: Factory and Production Management, Matériel, Tooling and Engineering. McDonnell Aircraft Corporation, Ambassador Building, St. Louis 1, Mo.

Aeronautical Engineers—for immediate work, the long-established Aeronca Aircraft Corporation seeks project engineers, design engineers, weight engineers, and layout draftsmen. These positions offer unusual permanent opportunities with the pioneer light-plane company of America for qualified men. Write in complete detail to Aeronca Aircraft Corporation, Box 00, Middletown, Ohio.

Instructor—In department of mechanical engineering to teach mainly aerodynamics, aeronautical design, and develop aeronautical laboratory. Advanced degree desired. Appointment April or September as Instructor or Assistant Professor, dependent on



An Angle of Attack Indicator has emerged from an intensive Kollsman development and flight research program with promise of considerable usefulness to the industry. Because of the close relationship that angle of attack bears to aerodynamic efficiency of the aircraft, this indicator offers interesting possibilities in its application both to long range fuel saving problems and to the indication of safe flight speeds of the aircraft. In the Kollsman system the position of a freely moving vane operating in the airstream is remotely indicated on the pilot's instrument panel, giving constant indication of the angle at which the main airfoil is striking the airstream. Reference markers on the dial may be set at pre-determined positions in the manner shown in the illustration to designate the stall point and also the most efficient angle of attack. Provision for a visual or audible stall warning signal is included. The unit also may be used as a yawmeter.

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

qualifications. Location Philadelphia. Address inquiries to Box 477, Institute of the Aeronautical Sciences.

Design Draftsmen—To prepare working plans and detail drawings of new or improved products, sketching from engineering notes; checking designs for engineering accuracy; supervising some Detail Draftsmen who may be assisting. At least 5 years' experience required. Salary of $50 to $70 for 40-hour week, time and one-half for any overtime. Address inquiries to Box 476, Institute of the Aeronautical Sciences.

Aeronautical Engineers—Prominent light-plane manufacturer located in New York area seeking qualified aeronautical engineers including aerodynamicists, stress analysts, loftsmen and draftsmen, particularly those experienced in molded plywood and sheet metal structures. Military and civil contracts. Address inquiries to Box 466, Institute of the Aeronautical Sciences.

Assistant Chief Aircraft Designer—Good background and experience in civil aircraft and conversant with C.A.A. requirements. Permanent position with aircraft manufacturer in Central Eastern Coast area. Reply by letter giving particulars as to experience, salary desired, and date available. Address inquiries to Box 463, Institute of the Aeronautical Sciences.

Chief Stressman with C.A.A. requirements experience, and **One or Two Assistants,** to take charge new project. Permanent position with aircraft manufacturing firm on middle eastern coast. Reply stating full particulars of past experience, salary required, and when free to take up a new position. Address inquiries to Box 462, Institute of the Aeronautical Sciences.

Layout and Detail Draftsmen, Senior and Junior—Required for progressive aircraft program with aircraft manufacturing firm on middle eastern coast. Reply stating full particulars of past experience, salary required, and when free to take up a new position. Address inquiries to Box 461, Institute of the Aeronautical Sciences.

Aircraft Design Engineers—Immediate permanent openings for design engineers with good experience in aerodynamics, structural design and C.A.A. airworthiness requirements with aircraft manufacturing firm on middle eastern coast. Reply stating full particulars of past experience, salary required, and when free to take up a new position. Address inquiries to Box 460, Institute of the Aeronautical Sciences.

Designing Draftsman—Design ignition components of electronic and electromechanical nature. Also do follow-up on experimental orders. Should be conversant with design for low-cost production. Starting salary of $70 to $85 for 40-hour week; time and one-half for any overtime. Address inquiries to Box 458, Institute of the Aeronautical Sciences.

Assistant Engineer—Design work, test work, test analysis, and creative development work in high-frequency ignition and electrical test equipment program. Must have experience in modern electronic design, test and development methods. Starting salary of $4,200 to $4,800. Address inquiries to Box 456, Institute of the Aeronautical Sciences.

Aeronautical Engineers—Immediate positions open in Washington, D.C., for aircraft engineers with practical experience in structural design and research. Salary between $3,640–$5,180 per year. In applying please give brief sketch of personal qualifications, education, and experience. Address inquiries to Box 448, Institute of the Aeronautical Sciences.

Stress Analyst—Engineer with experience in design of rotary wing aircraft rotor blades. Must have thorough knowledge of rotor blade stress and aerodynamic analysis procedure, experimental procedure for determination of static and dynamic stresses and fatigue research methods. Permanent position involving study of wood, metal, and plastic blades. Address inquiries to Box 443, Institute of the Aeronautical Sciences.

Assistant Professor of Aeronautical Engineering—Must have experience in structural analysis and design. Permanent position. Applicants should furnish details describing education, experience, and personal data. College located in Virginia. Address inquiries to Box 442, Institute of the Aeronautical Sciences.

Assistant Professor—To conduct senior and graduate courses, develop laboratory, and direct research in aircraft power plants, with emphasis on standard aircraft engines and accessories. Advanced degree preferred. Position with an established aeronautical engineering department of a large eastern university. Appointment September, 1946. Salary open. Address inquiries to Box 434, Institute of the Aeronautical Sciences.

Aircraft Layout Draftsmen—Familiar with layout and design of aircraft sheet metal structures, controls, mechanisms, power plant, electrical systems and equipment. Excellent opportunities for experienced personnel interested in helicopter design. Address inquiries to Box 414, Institute of the Aeronautical Sciences.

Assistant or Associate Professor—To conduct undergraduate and graduate work in theory, design, and research in propellers and jet and rocket propulsion systems. Applicant should have at least one graduate degree and a sound theoretic and applied background in the thermodynamics and aerodynamics of propulsion systems. Large Midwestern University. Address inquiries to Box 413, Institute of the Aeronautical Sciences.

General Manager—A medium-sized aircraft company has opening for man qualified to direct manufacturing, sales, quality, personnel, accounting, and engineering functions. Must have long experience in management and good education. Company working on Government contracts, commercial aircraft production, and other manufacturing. Address inquiries to Box 410, Institute of the Aeronautical Sciences.

Research Fellows—To work half time on industrial research programs and study half time for M.S. or Ph.D. degree. Salary $1080 for 12 months together with freedom from tuition fees. Extra compensation during summer months may be obtained by working full time. Address inquiries to Box 398, Institute of the Aeronautical Sciences.

Research Engineer—To work on industrial research program. Electrical, mechanical, or civil engineering degree and some experience in materials-testing and vibration theory desirable. Salary $2600 or more depending on experience. Address inquiries to Box 397, Institute of the Aeronautical Sciences.

Engineer of Tests—To take charge of commercial and industrial structures and materials tests. M.S. degree and laboratory experience desirable. Opportunity to work for doctorate. Salary $3000 or more for 12 months depending on experience. One month vacation with pay. Address inquiries to Box 396, Institute of the Aeronautical Sciences.

Project Engineer—Experienced and talented design man to undertake the responsibility for a new aircraft project from inception to completion. Plant located on eastern seaboard. Salary scale above average. Write full particulars. Address inquiries to Box 370, Institute of the Aeronautical Sciences.

Works Manager—Manufacturing executive to set up and operate a production program on a new aircraft. Will direct Manufacturing, Facilities, Inspection and Procurement Departments. Salary scale above average. Located on eastern seaboard. Write full particulars. Address inquiries to Box 369, Institute of the Aeronautical Sciences.

Airplane Salesmen—Large established producer of personal aircraft seeking several qualified airplane salesmen with both flying and merchandising experience. Interview in New York. Address inquiries to Box 362, Institute of the Aeronautical Sciences.

Executives of air lines who are responsible for operating their companies at a profit are anticipating commercial aviation gasoline of even higher antiknock quality . . . and engines designed to utilize it. They realize that such a combination will help to increase payloads and cut costs during the years of intense competition which lie ahead.

Ethyl Corporation

Chrysler Building,
New York City

ETHYL
BRAND OF ANTIKNOCK COMPOUND
ETHYL CORPORATION
TRADE MARK REG. U.S. PAT. OFF.

Manufacturers of Ethyl fluid, used by oil companies to improve the antiknock quality of aviation and motor gasolines.

Assistant Sales Manager—Large established producer of personal aircraft seeking qualified assistant sales manager. Interview in New York. Salary commensurate with ability. All replies treated confidentially. Address inquiries to Box 361, Institute of the Aeronautical Sciences.

Associate Professor of Aircraft Structures—To teach senior and graduate courses in aircraft structural theory, develop structures laboratory, and direct graduate structural research work. Practical experience necessary. Advanced degrees preferred. Permanent position. Leading State University. Location—Midwest. Address inquiries to Box 340, Institute of the Aeronautical Sciences.

Associate or Full Professor: To teach advanced courses and direct research in the Aircraft Power Plant Design field. Recent experience in turbine and jet engine design and testing necessary. Advanced degrees preferred. Permanent position, large mid-western university. Can wait six months if necessary. Address inquiries to Box 339, Institute of the Aeronautical Sciences.

Assistant or Associate Professor of Aerodynamics—Young man with Ph.D. to teach graduate courses in theoretical aerodynamics and direct theoretical and experimental research in this field. Research experience necessary. Position permanent. Mid-western State University. Address inquiries to Box 338, Institute of the Aeronautical Sciences.

Associate or Professor of Aerodynamics—To teach performance, control, stability and develop correlating flight test and flight instrumentation courses for large mid-western university. Position permanent. Practical experience necessary. Advanced degrees preferred. Address inquiries to Box 337, Institute of the Aeronautical Sciences.

Patent Engineer—Familiar with patent disclosures and procedures. Essential helicopter industry. Salary commensurate with experience and present earning capacity. Address inquiries to Box 322, Institute of the Aeronautical Sciences.

Assistant Professor—To teach Mechanics, Strength of Materials, and Physics in a small Mid-western College. Must have Master of Science Degree, preferably in Engineering or Physics. Salary dependent on qualifications and experience. Position permanent. Address inquiries to Box 291, Institute of the Aeronautical Sciences.

AVAILABLE

Engineer—E.E.; Executive or Administrative. Thirty-one years old. Ten years' experience electronics, servos, aircraft and industrial controls, ignition, sales engineering. Qualified in automatic temperature and propeller pitch controls and automatic pilots. Previous positions: head of research lab, central office engineer, assistant chief engineer, chief engineer. Capable of directing activities and handling men. Responsible position. Available immediately. Address inquiries to Box 271, Roslyn, L. I., New York.

Aeronautical Engineer—Former Army pilot (all types) and engineering officer. Many years' experience in design, inspection, manufacture and test. Hydraulics and supercharger specialist. Broad knowledge of aerodynamics, thermodynamics, and design practice. Excellent engineering draftsman; holder of patents; many ideas for future development. Desires development work on engines or airplanes. Address inquiries to Box 478, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. degree. Civilian experience: 1 year as aerodynamicist specializing in wind tunnel. Military experience serving with Navy as aircraft engineering officer. Age 25, married. Available in July. Desires responsible position in East or Mid-West as Aerodynamicist or Flight Test Engineer. Address inquiries to Box 475, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S.Ae.E. degree, 26 years old, World War II veteran. Six months' experience as Fuel System Design Engineer with Air Technical Service Command, U.S.-A.A.F. Over three years' experience in the U.S. Air Corps as Flight Engineer and Maintenance Chief on heavy bombardment-type aircraft. Experienced in supervising groups. Desires a permanent design or layout position with aircraft manufacturer. Any location in the United States will be considered. Address inquiries to Box 474, Institute of the Aeronautical Sciences.

Administrative Engineer—B.A.E. Seven years' experience in airplane design (preliminary and production), research, shop work, factory liaison, and salvage work. Group Leader. Airplane and helicopter experience. Available soon as assistant to busy executive in general management or engineering; aircraft or allied field. New York area preferred but not essential. Address inquiries to Box 473, Institute of the Aeronautical Sciences.

Design Engineer—B.S. Ae.E.; age 29. Five years' experience with major aircraft manufacturer on design, procurement and service liaison; supervision of engineers. Experienced in investigation of service difficulties and redesign, follow-up. Extensive mechanical background. Desires position in design or sales engineering. Location open. Address inquiries to Box 472, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in Ae.E., 14 years' flying and 12 years' engineering experience including design problems, development of test and control devices, performance studies and conduct of airplane, power plant and accessory flight-test projects, seeks product-improvement position requiring design aptitude and test ability. Interests not restricted to aircraft field provided employer can benefit from aviation background. Address inquiries to Box 471, Institute of the Aeronautical Sciences.

Aircraft Power Plant Engineer—B.S. in M.E.; 12 years' in aviation with leading aircraft engine manufacturer. During recent years in charge projects, including personnel, involving installation, operation, maintenance, and overhaul of aircraft powerplant equipment. Qualified to assume complete management of such projects. Wide acquaintance with key personnel airlines, aircraft manufacturers, distributors, service bases, A.A.F., and Navy Bureau of Aeronautics. Travel or live anywhere. Address inquiries to Box 470, Institute of the Aeronautical Sciences.

Chief or Assistant Chief Engineer—M.I.T. graduate, age 36, extensive background in research and development work and air transport engineering. Ex-Lieutenant Colonel A.A.F. Formerly Chief Aeronautical Engineer of large foreign air transport division handling all phases of aircraft engineering, maintenance, flight test, etc. Production engineering experience with A.A.F. Matériel Command at Wright Field. Heavy prewar experience in aircraft-engine development and testing. Desires position with good future leading to executive status. Location open; available immediately. Address inquiries to Box 469, Institute of the Aeronautical Sciences.

Expert Mechanical Design Engineer—Fifteen years' internal combustion engine design experience, including 3 years on diesel engines, 6 years on aircraft engines, last 2 years on high-temperature rotating machinery including gas-turbine aircraft auxiliary power plant. Interested in design supervision, engineering liaison, or sales engineering. Address inquiries to Box 468, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Spanish-born and educated, author of English-Spanish aviation dictionary. Will undertake technical translations into European or Latin-American Spanish; books, brochures, advertising copy. Address inquiries to Box 467, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Doctor of Aeronautical Engineering desires associate or assistant professorship in aeronautical department of university. Good teaching experience in aerodynamics and aircraft structures; several years in aviation industry on airplane design. Address inquiries to Box 465, Institute of the Aeronautical Sciences.

Tool Engineer—Aircraft and machine-shop experience; desires subcontracts for tool design, processing or special machinery. Address inquiries to Box 464, Institute of the Aeronautical Sciences.

Engineer—Four years' experience as layout draftsman on wood and aluminum-alloy construction; desires position as project group leader; location in eastern states preferred. Address inquiries to Box 457, Institute of the Aeronautical Sciences.

Planning and Scheduling Engineer—M.E. degree, 1940, Carnegie Institute of Technology (Aero Option). Six years of experience. One year of experience in planning and scheduling the complete airplane before design given to project. Actual job coordinated with a representative from the factory and representative from engineering production design department and himself. Three years of experience in structural design supervision. One year of experience in engineering liaison. Desires position breaking down the design, planning the component parts and scheduling, and following its progress throughout its engineering design stages. Address inquiries to Box 455, Institute of the Aeronautical Sciences.

Management Executive—Vice-president and general manager of engineering for consulting company doing war work seeks new connection. Twenty years' experience as executive in engineering, production, and general management. Specially qualified as an organizer and production consultant. Experienced major air-line executive. Address inquiries to Box 454, Institute of the Aeronautical Sciences.

Executive—Age 37, single, Protestant, English-American. Fifteen years' continuous, well-rounded aircraft experience. Has experience in ground and flight instruction; airport and seaplane base management; airplane sales (sold over 50 aircraft prewar); charter and photographic; airline; manufacturing (inspector to factory manager); C.A.A. (inspector), quality control, engineering, research, and development. Was a key man with prime contractor (airframe) during the war (now reconverting to non-aeronautical product). Has valid commercial pilot, seven ground instructor, A. & E., radio operator, and F.A.I. glider pilot certificates. Familiar with latest metal, plastic bonded wood, and composite aircraft techniques; also conventional, amphibious, and rotating wing aircraft. Desires position where knowledge, experience, initiative, and results are of prime importance. Last salary—$7,000. Address inquiries to Box 453, Institute of the Aeronautical Sciences.

Engineer - Executive - Consultant—B.S. in Aero Eng., B.S. in Business Administration, University of Minnesota. Formerly assistant to factory superintendent, major aircraft company; assistant chief engineer, aircraft parts plant; quality manager, aircraft parts and assembly company. Presently on Staff of Naval Air Operating Command responsible for operation of structures, engines, including turbojet, electronics, ordnance, instruments, photographic, and safety equipment departments. Familiar with design, maintenance, and operation of all combatant, utility, and transport type naval aircraft. Desires permanent position preferably in the Middle West offering executive responsibilities in an administrative consultant or advisory capacity. Will consider any position requiring initiative, responsibility and a combination of business and engineering training and experience. Available immediately. Address inquiries to Box 452, Institute of the Aeronautical Sciences.

Pilot—Engineer—World War II veteran with five years' flying experience in the U.S. Marine Corps. B.S. in Mechanical Engineering (Aero Option), Virginia Polytechnic Institute. Holds a valid commercial pilot certificate. Prefers a position involving flying. Will locate anywhere. Address inquiries to Box 450, Institute of the Aeronautical Sciences.

Inspector and Quality Control Engineer—Five years' experience with high-altitude fighter planes, desires employment with an air line. B.S. degree; speaks three foreign languages fluently; any location. Address inquiries to Box 449, Institute of the Aeronautical Sciences.

Aeronautical Engineer—With own design of practical roadable airplane having basically new and desirable features seeks connection with aircraft manufacturer who has well-established manufacturing facilities but needs a product. M.I.T. Graduate with 10 years' sound aircraft engineering experience. Address inquiries to Box 447, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. Fourteen months' aircraft experience in application and development of new materials and processes, trouble shooting, production testing, specification writing. General design experience (studio). Two articles published in *Aero Digest*. Young, with initiative. Any location. Desires position with development group of production-minded manufacturer. Address inquiries to Box 446, Institute of the Aeronautical Sciences.

Aircraft Design Engineer—Has aeronautical education. Seven years' experience in many phases of aircraft design, including layout drafting, testing, and liaison on aircraft equipment installation. Desires responsible position in engineering or experimental department of small aircraft or aircraft equipment manufacturer, or air line. Willing to travel. Address inquiries to Box 445, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Twenty-two years old. Will graduate March 29, 1946, from aeronautical school. Has lived in Spanish-American country for 16 years. Writes and speaks Spanish and English fluently, thoroughly acquainted with Latin customs. Desires position in which engineering training and knowledge of Spanish and English would be of value, either in the United States or Latin America. Address inquiries to Box 444, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in A.E.; age 32. Experienced in layout, design, stress analysis, and supervision in plywood and all-metal aircraft and helicopters including basic design and simplification of structures. Desires position in Mid-West if possible. Present location, Detroit. Address inquiries to Box 441, Institute of the Aeronautical Sciences.

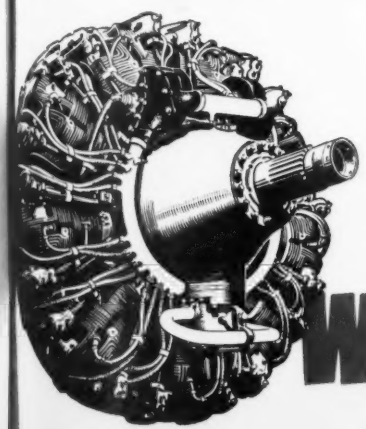
Mechanical Engineer—M.S.E.; 32 years old; with good background in mathematics, applied mechanics, vibrations. Varied experience in research, development, and testing of mechanical products. Thoroughly familiar with mechanical laboratory methods and equipment. Desires position requiring such knowledge and experience, preferably with research and development organization. Address inquiries to Box 440, Institute of the Aeronautical Sciences.

Engineer—Administrative Liaison—Aeronautical Administrative Engineer—Seven years' air-line operation maintenance experience with international air line and U.S. Naval Air Transport Service. Lieutenant Commander, Squadron and Staff Engineering Officer. B.S. in Mechanical Engineering (Aero Option), University of California. One year, Harvard Business School. Permanent position with international transportation concern desired. Available immediately. Address inquiries to Box 439, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Fourteen years actively engaged in the aircraft industry, including project design, flight test, and development engineering, and as representative in procurement and field service. Thorough knowledge of maintenance and flight operation, including A. and E. licenses and 7 years' flight experience. Present affiliation with major aircraft company, entered in 1937. Desires permanent responsible position and opportunity for advancement, commensurate with ability, in development, sales, or as technical representative. Geographical location unimportant. Four years of university work and graduate of two leading schools of aeronautics. Understands Spanish and French. Excellent commercial and military references. Address inquiries to Box 436, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E., University of Minnesota. One year

Ambassador of world trade



Pan American World Airways, veteran ambassador of trade, now makes one market place of the world . . . bringing the wares and wants of many nations together to create sales and prosperity . . . with Lockheed Constellations powered by Wright Cyclones.

WRIGHT *Aircraft Engines*

Wright Aeronautical Corporation *Paterson, New Jersey, U.S.A.*

DIVISION OF
CURTISS WRIGHT
FIRST IN FLIGHT

For commercial and executive aircraft...

The Collins 18S-1 Radio Transmitter-Receiver

60 pounds . . . 1½ ATR Unit
100 watts . . . 20 frequencies

The 18S-1 airborne radio transmitter-receiver is designed specifically for commercial airlines and executive aircraft. It is a product of years of experience and proved competence in the field of aircraft radio communications.

The transmitter develops 100 watts of r-f power on any of 20 optional crystal controlled frequencies within its range. Quick, automatic frequency selection is provided, with all circuits tuned and ready to operate. The receiver is controlled by a separate group of crystals; therefore the equipment can be set to transmit and receive on any desired combination of frequencies.

A single 1½ ATR cabinet contains transmitter, receiver, and dynamotor power supply for the transmitter. The receiver operates directly from the 26.5 volt d-c source. The entire weight, including antenna unit, is 60 pounds.

Remote control facilities, at the pilot's or radio operator's position, permit locating the 18S-1 wherever desired from a standpoint of weight distribution, with the antenna loading unit adjacent to the antenna feed-through. All circuits are pretuned to the selected frequencies, obviating the need for tuning controls.

The 18S-1 can be installed easily by the aircraft manufacturer, the airline service department, a dependable aircraft radio service organization, or by Collins personnel in the Collins hangar at the Cedar Rapids Municipal Airport. We will welcome your inquiries. Write today to the Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.

SPECIFICATIONS:

Weight: 60 pounds overall.
Size: 1½ ATR unit.
Frequency range: 2,500-15,000 kc.
Number of optional frequencies: 20.
Frequency control: Remote master switch controls Autotune* on antenna tuning unit, and motor driven switches inside 18S-1.
Carrier power: 100 to 125 watts output from the power amplifier.
Type of emission: voice modulation.
Monitoring facilities: sidetone output to headphones.
Receiver features and characteristics:
One stage r-f amplification.
Image rejection 55 db minimum.
Bandwidth 4 kc at 6 db down and not over 15 kc at 60 db down.
avc and automatic noise limiter.
200 to 300 milliwatts output into 300 ohm load.
Full output with only 5 microvolts r-f input.
Up to 3 volts r-f input without blocking.
Dual output optional.
Power source: 26.5 volts d-c.

*The Autotune is an electrically controlled means of mechanically repositioning variable components such as capacitors, inductors, and switches.

IN RADIO COMMUNICATIONS, IT'S . . . . .

detail design and minor layout drafting. Over four years' service with Air Technical Service Command, U.S.-A.A.F., as engineering officer. Military experience included one year of checking contractor-submitted stress analyses and the design and supervision of installation, in aircraft, of experimental equipment; three years as resident liaison engineer for A.A.F. at large West Coast aircraft manufacturer. Served three months in England and Germany with Air Technical Intelligence Section of U.S. Strategic Air Forces as technical investigator of German aircraft development. Desires permanent position with opportunity for advancement in technical or administrative engineering or allied field. Los Angeles area preferred. Available immediately. Address inquiries to Box 435, Institute of the Aeronautical Sciences.

Engineering Draftsman—Four and one-half years' experience in aircraft work, 1 year, sheet metal layout; 6 months, tool design; 2 years, aircraft hydraulics; and 1 year, shop liaison. Three years of college. Desires position in Chicago area with organization offering future. Will consider position in other than aircraft industries, but aircraft industry preferred. Draft exempt. Excellent references available June 1. Address inquiries to Box 433, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Graduate work in Ae.E. Almost 6 years' experience in flight test, stability and control, and wind-tunnel testing on multiengined landplanes and seaplanes with large company. Desires stability and control or flight-test work with West Coast air line. Address inquiries to Box 432, Institute of the Aeronautical Sciences.

Engineer—Manufacturer—Eighteen years in aircraft industry. Experienced as Chief Engineer of large aircraft company during the war. Also experienced in operation of own company manufacturing subcontract aircraft parts. Desires position with small company having proprietary articles to engineer, manufacture, and sell. Have private pilots' license and fly own light airplane. Address inquiries to Box 431, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Officer R.C.A.F. Engineering education. Six years' aircraft maintenance, liaison inspection and engineering in manufacture and overhaul of military aircraft. Considerable technical administration work. Glider construction and design experience. Desires position whereby technical qualifications can be utilized and experience to a more advanced standing possible. Future opportunity is the prime requisite. Address inquiries to Box 430, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Five and one-half years' experience in Airline Engineering (Operation and Maintenance) and Aircraft Manufacturing. Two degrees in Aeronautical Engineering. Part time work desired. Address inquiries to Box 429, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. Two and one-half years' experience with a leading aircraft manufacturer as layout draftsman and preliminary stress analyst. Served with Marine Corps Aviation as Commanding Officer of service squadrons, Group Engineering Officer, at present Production Superintendent of overhaul activity. Nearly five years of active duty in U.S. and overseas. Desires to become connected with engineering staff or air line for maintenance, overhaul work, or allied subjects. Address inquiries to Box 428, Institute of the Aeronautical Sciences.

Engineer—World War II veteran, engineering degree. Eight years' flying experience in U.S. Navy, 4 years service engineering, 2 years test-pilot and development work. Qualified in various types service planes including single and multiengine, both land and sea. Recent experience in jet-propelled aircraft. Desires opportunity to do research and development work including flying. No objection to traveling. Excellent references. Address inquiries to Box 427, Institute of the Aeronautical Sciences.

Air Passenger Research—College graduate, experienced. Available temporary or permanent. Address inquiries to Box 426, Institute of the Aeronautical Sciences.

Chief Engineer, Mechanical, Development and Research—Wide experience, automotive and aeronautical, ball and roller bearings and all applications, gears, landing gear; initiated current propeller; mature judgment, capacity for detail, executive experience. Ability to analyze new design, foresee possibilities, and carry from start to production drawings. Now have paying consulting business but prefer direct responsibility. Address inquiries to Box 425, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in General Engineering from Georgia Tech. 24 years of age. Three years' experience in dynamic stability research; duties included design of wind-tunnel models and some maintenance and wind-tunnel operation. The last 6 months have been spent in development and flight tests of rocket-propelled missiles. Desires position as aerodynamicist or flight test engineer, preferably on development of new design. Excellent references. Address inquiries to Box 424, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Graduate with eighteen years of practical experience in aircraft design and engineering with emphasis on aerodynamics, wind-tunnel testing, flight-testing, power plants and weights control. Desires a supervisory position in connection with aircraft design and development engineering or flight test. Address inquiries to Box 423, Institute of the Aeronautical Sciences.

Aeronautical Engineers—Recently incorporated organization of experienced engineers is interested in designing a complete airplane or any of its parts. Aerodynamic, structural, and power-plant installation problems capably executed. Complete responsibility will be assumed for obtaining C.A.A. approval. The diversified background of our engineering staff in designing for production assures a product which not only incorporates sound engineering, but also can be manufactured economically. Address inquiries to Box 422, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. degree. Five and one-half years' experience in stress analysis and design of large aircraft structures with a large eastern concern. Familiar with all parts of the airplane. Part time spent as group leader. Mid-West location preferred. Would like airline work. Address inquiries to Box 421, Institute of the Aeronautical Sciences.

Engineer—One and one-half years' experience as structural test engineer and stress analyst with major aircraft company. M.E. graduate of Lowell Institute School, M.I.T. No objection to traveling. Address inquiries to Box 420, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in Ae.E. with approximately 12 years' experience in military and civil airplane engineering. Complete structural responsibility on recent Navy and Army fighter airplanes with large organization. Inventive ability and productive minded. Knowledge of loads, vibrations, and flight testing. Experienced in supervising large group. Desires a permanent and responsible design or stress position in progressive organization in East or Middle West where his experience and abilities can be fully utilized. Address inquiries to Box 419, Institute of the Aeronautical Sciences.

Aeronautical Engineer, Executive—B.Ae.E., age 33, Commander U.S.N.R., available shortly. Seven years' experience in design, development, modification, overhaul and maintenance of naval aircraft, both production and experimental types. Particularly strong on structures. Administrative experience. Desires responsible position where initiative and capabilities can be employed. No objection to traveling. Willing to locate anywhere. Will consider affiliation with progressive nonaircraft or-

Today there is no Reason why Every Engine Should not Enjoy the Advantages of Sodium Cooled Valves

★

The EATON E-100 SODIUM COOLED VALVE is a Better Valve at Lower Cost

★

Performance records—both in the engineering laboratory and in actual service—prove that the new Eaton E-100 sodium cooled valve is the finest valve ever produced. Yet, through a combination of design and production economies, the E-100 valve actually costs *less* than its predecessors. It is economically practical for every engine application—aircraft, passenger car, truck, marine, and industrial. ¶ Specific improvements include greater strength and ability to maintain normal shape at elevated temperatures; more efficient cooling; improved resistance to face corrosion, through the use of Eatonite alloy. ¶ Eaton engineers will be glad to discuss the new E-100 valve, and present performance data which will prove interesting to all engine builders.

POPPET VALVES • SODIUM COOLED VALVES
TAPPETS • HYDRAULIC VALVE LIFTERS
VALVE SEAT INSERTS • ROTOR PUMPS

© 1946. EATON MFG. CO.

EATON
MANUFACTURING COMPANY
WILCOX-RICH DIVISION
8771 French Road • Detroit 13, Michigan

ganization. Address inquiries to Box 418, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Bachelor's and Master's degrees in aeronautical engineering. Eight years' experience with Army, Navy, and commercial types covering all existing types of construction. Experienced in aerodynamics, structures, basic and detail design, and development and experimental work. Good knowledge of shop practices and thoroughly familiar with C.A.A. design requirements, including new CAR 03. Prefers work on small and medium-sized commercial aircraft. Any location considered. Address inquiries to Box 417, Institute of the Aeronautical Sciences.

Aeronautical Management Engineer—Registered professional aeronautical engineer with over 18 years' broad supervisory experience in aircraft engineering and production. Organization, Methods and Procedures, and Maintenance. Five years as Mechanical and Electrical Engineer. Will set up or improve organization, administrative and other control procedures, production and inspection methods and procedures, production and maintenance design; cut manufacturing, operating, and maintenance costs, initiate and maintain liaison with Government and industry for Air Line or Aircraft Manufacturer. Recently Chief, Maintenance Control and Chief, Methods and Procedures, for 2 years with U.S. Army Strategic Air Forces and Air Technical Service Command. Address inquiries to Box 416, Institute of the Aeronautical Sciences.

Executive Engineer—Graduate engineer with eight years' aircraft experience including production planning, cost estimating, master scheduling, and past five years senior design engineer. Prefers Mid-West location in aircraft or allied field. Address inquiries to Box 415, Institute of the Aeronautical Sciences.

Manufacturing Executive—Twenty years' experience, mostly aircraft, all phases manufacturing and procurement. Specialized in planning, material control, estimating, production control, procurement and production management. Available immediately. Address inquiries to Box 412, Institute of the Aeronautical Sciences.

Engineer—Wing structures specialist. Ten years' experience, seven in structural design, three in stress (including fuselage bending analysis as well as wing). In charge of structure for thin airfoil design nearing completion. Anxious to do more work in thin airfoils and assume more responsibility. Address inquiries to Box 411, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S.Ae.E., and C.A.A. Aircraft Mechanic Certificate. Experience consists of seven months in aircraft manufacture while attending college, and two years, since graduating from college, in maintenance and design engineering on four-engined transports for commercial airline. Interested in position with another air line, manufacturer's field service technical representative, or similar work. Any location considered. Address inquiries to Box 406, Institute of the Aeronautical Sciences.

Aeronautical Engineer (native Russian)—Would like to translate Russian scientific and technical papers. Thoroughly acquainted with the field of theoretical and applied aerodynamics. Address inquiries to Box 405, Institute of the Aeronautical Sciences.

Aeronautical and Mechanical Engineer—B.S., S.M. Broad experience in theoretical and experimental stress analysis, vibration theory, and instrumentation. Project organization and customer liaison work. Long residence in the Orient. Speaks and writes Russian fluently; some French and Chinese. Interested in responsible position with consulting firm or similar organization having foreign contacts. Address inquiries to Box 404, Institute of the Aeronautical Sciences.

Aeronautical Engineer—M.S. in Ae. and Me.E., 1924. Research, Preliminary design, Development. Past experience includes: Consulting Engineering (research, coordination of new developments); Project Engineer, Aerodynamicist, Research Engineer. High references. Prefers location in United States or Canada. Address inquiries to Box 402, Institute of the Aeronautical Sciences.

Development Engineer—Aeronautical engineering degree, industrial management training. Five years' experience in aircraft engine design and research aircraft production, editing. Ideal assistant for busy executive. Will conduct correspondence and technical writing, assist in project administration, planning and coordination, or handle strictly technical assignment. Address inquiries to Box 400, Institute of the Aeronautical Sciences.

Hydraulic Service Engineer—One year at Purdue University; one year at Indiana University Extension. Graduated from Aviation Mechanical School, Curtiss-Wright Tech., Glendale, Calif., with high scholastic honors. Approximately six years' experience in aircraft hydraulics as teacher, designer, mechanic, and school supervisor. Taught and supervised aircraft hydraulics at Curtiss-Wright Tech. Established, taught, and supervised aircraft hydraulics at Utah State College at Logan, Utah. During the past 3 years, while in the Navy, has been assigned to duty as hydraulic supervisor and established one of the largest aircraft hydraulic schools in the country. During these 3 years has also designed and constructed hydraulic valves, fittings, test benches, and mock-ups for Navy use. Possesses a C.A.A. airplane mechanic certificate. Mechanical background: welder, lathe operator, riveter, etc. Address inquiries to Box 399, Institute of the Aeronautical Sciences.

Test Pilot—B.S. in A.E., Oregon State College. Five years of Navy flying, including Instructor in single and multiengine aircraft: 1,000 hours four-engine time; 1,000 hours twin-engine time; 2,800 hours total. Thirteen months of Aleutian flying, Navy Maintenance Officer, Weight and Balance. Holds commercial, instrument, and radio licenses. Desires engineering test with foreign or domestic company. Address inquiries to Box 395, Institute of the Aeronautical Sciences.

Mechanical-Aeronautical Engineer—B.S. in M.E., University of Michigan. Seventeen years' experience with aircraft manufacturers, air lines, and aircraft maintenance equipment manufacturer. Designed and patented manufacturing and maintenance equipment now used extensively in the industry. Held responsible positions in development, design, sales and management. Broad general experience in most phases of the aeronautical industry throughout the United States. Desires executive position with an air line or allied industry manufacturing aircraft, aircraft equipment, or maintenance equipment for the air lines. At present is a naval officer on air-transport engineering duty. Expects to be released to inactive duty in January, 1946. Address inquiries to Box 394, Institute of the Aeronautical Sciences.

Aeronautical Engineer—University Michigan graduate with 20 years' design and executive experience, desires responsible position with aircraft manufacturing, aircraft accessory, or air-line organization. Experienced on Army, Navy, and C.A.A. Requirements. Address inquiries to Box 393, Institute of the Aeronautical Sciences.

Project Engineer—B.S. in M.E., Aero. E. Thirty-five years old. Over 10 years of aircraft design, structural layout and administrative duties. Seven and one-half years of supervisory experience in engineering, seeking executive or supervisory position, not necessarily in aviation. Location open. Address inquiries to Box 392, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. Aero. Eng., New York University, 30 years old, married. Eight years' experience in design and design supervision as Group Leader and Assistant Project Engineer for various prime contractors of military aircraft. Complete and varied experience in all phases of aircraft design, including structural, power-plant installation, controls, armament, equipment, hydraulics, etc. Also shop experience, engineering shop contact, flight-test, and general administrative experience. Responsible position in any field considered. Location on East Coast preferred, but not essential. Address inquiries to Box 391, Institute of the Aeronautical Sciences.

"The Modern Magic Carpet"* Will Blaze New Highways to Inaccessible Places

BECAUSE of their ability to ascend and descend vertically... fly forward... backward... sideways... hover ... and land in and take off from any terrain where sufficient space is provided for the clearance of the rotors, helicopters will blaze new highways in the sky to hitherto inaccessible places.

These "Modern Magic Carpets"* will transport men and supplies swiftly and economically to localities and plants so out-of-the-way that they often are reached only by mule team or "shanks' mare."

Since Bell Helicopters will need no elaborate landing fields and terminal facilities they will offer Business and Industry the many advantages of fast point-to-point delivery.

Bell Helicopters are being built to perform many practical commercial, industrial and military applications for which the helicopter is more suited than conventional fixed wing airplanes and other forms of transportation ... and, in fact, is sometimes the *only* means of transportation.

Bell Aircraft's post-war interest in the helicopter is in engineering and building rotary wing aircraft incorporating the advanced design, workmanship and dependable operation which has won this company its place in the Aviation World for being the "Pacemaker of Aviation Progress."

*Reg. applied for U.S. and principal foreign countries.

BELL *Aircraft* **CORPORATION**

Buffalo 5, New York

© Bell Aircraft Corporation

PACEMAKER OF AVIATION PROGRESS

Design Engineer—Available on fixed basis for specific designs of aeronautical, structural or mechanical nature. For detail qualifications address inquiries to Box 390, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Pilot—Graduate Aeronautical Engineer with 2½ years in Army Air Forces, including "Aircraft Maintenance Engineering" course at Yale University and A.A.F. pilot training. C.A.A. Commercial Pilot and Ground Instructor. Desires position with flying school or engineering division of air line. Willing to work in foreign country. Address inquiries to Box 389, Institute of the Aeronautical Sciences.

Aerodynamicist and Physicist—B.S. in E.E.; M.S. in Applied Physics; 1½ years' Doctorate work in Applied Science. Seven years' teaching experience in university—Aerodynamics, Physics, Fluid Mechanics, and allied subjects including graduate level. Five years' experience as Aerodynamicist, Propeller Designer, and Stress Analyst. Prefers university position with research and consulting possibilities and a possibility of completing Doctorate, or responsible industrial position with good chances for advancement within commuting distance from approved graduate engineering or science college. Address inquiries to Box 388, Institute of the Aeronautical Sciences.

Technical Administration or Technical Sales—Over 20 years of aircraft experience which has covered airplane project design followed by ten years of technical administration work in the top management of two large airplane companies. Wishes responsible position in connection with technical sales. Address inquiries to Box 387, Institute of the Aeronautical Sciences.

Engineer–Executive—Twelve years' experience includes airplane design, stress analysis, and structures. Director of Aeronautical Engineering and Sales in aircraft accessories field. Wide acquaintance in the industry, including manufacturers, air lines, aircraft distributors, A.A.F.,, and Navy Bureau of Aeronautics. University graduate and professional aeronautical engineer. Seeks permanent connection as a key personnel in design, executive, or sales engineering, or as manager in the aviation department or technical adviser in nonaviation industry. Development and experimental work welcome. Address inquiries to Box 386, Institute of the Aeronautical Sciences.

Administrative Engineer—Graduate engineer with over 15 years' experience in design, research, and manufacturing. Eight years' experience in the administration of a division of engineering of a well known aircraft company. Desires a position of responsibility with a medium sized company that has good prospects for future advancement. Address inquiries to Box 385, Institute of the Aeronautical Sciences.

Engineer—B.S. in Aeronautical Engineering, licensed airplane mechanic, four years' experience. One year on aircraft design and development. Three years as research engineer on aircraft and other types of internal combustion engines. Chinese with good knowledge of language. Desires a responsible position in China in engineering, engineering sales, or as a technical representative in the aviation, oil, or automotive industry. Excellent references. Address inquiries to Box 384, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in Ae.E. (Mexican Citizen); speaks and writes Spanish. Desires position with a small company with good opportunities for advancement. Any location in the United States would be considered. Would also consider a position in Mexico as a representative of a company with business relations in this country. Address inquiries to Box 383, Institute of the Aeronautical Sciences.

Structures Engineer—B.S. in Aero. Engineering. Five and one-half years' stress experience with the Development Engineering Department of a large Aircraft Corp. Desires responsible position in the Los Angeles area. Address inquiries to Box 382, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Ae.E. Two years' experience as Foreman in Charge of Spinning Aircraft Fabrics, two years in Hydraulics and Contact Work, three and one-half years as Design Engineer in Aircraft Turret Work, including Design and Layout Work in Armament. Desires position as Sales Engineer or Project Development work. West Coast or Midwest location preferred. Will accept work in Foreign Country. No objection to traveling. Available immediately. Address inquiries to Box 381, Institute of the Aeronautical Sciences.

Quality Control Manager, Chief Inspector—Eighteen years' aircraft experience. Excellent references. Army or Navy work preferred. Location East Coast. Address inquiries to Box 378, Institute of the Aeronautical Sciences.

Mechanical and Aeronautical Engineer—B.S. in M.E., Aeronautical Engineering Option, 1936. Candidate for M.S. degree in Mechanical Engineering with graduate work to be completed during first year after release from active duty. Two years' experience Machine Tool Design and Drafting; three and one-half years' experience in Aircraft Propeller Design and Vibration Research; one-half year experience in Aeronautical Research; thirty-nine months' service as officer in Army Air Forces Air Technical Service Command's Engineering Division Laboratories and Central District as Project Officer. Highest references. Location near New York City preferred. Address inquiries to Box 376, Institute of the Aeronautical Sciences.

Development Engineer—Graduate Engineer, B.S. in Ae.E., with 6½ years of aircraft and machine design experience, including design of and fabrication contact for varied mechanisms, landing gears, and hydraulic units. Location in Eastern district preferred. Particularly interested in smaller company with expanding postwar plans, in which advancement is possible along with the company. Address inquiries to Box 375, Institute of the Aeronautical Sciences.

Stress Analyst, Design and Development Engineer—B.S. in aeronautical engineering; five years' experience in aeronautical engineering after graduation. Structural design and analysis experience with large manufacturer of military landplanes and seaplanes. More than two years' work in the investigation and development of new structural materials and types of construction including magnesium, plastics, sandwich construction. Experience in latest structural test methods; one-and-a-half years' experience as design project officer in Bureau of Aeronautics with engineering cognizance over production and experimental models. Desires permanent position as assistant design project engineer or as structures analytical or test engineer with East or West coast manufacturer. Address inquiries to Box 374, Institute of the Aeronautical Sciences.

Engineer, Development or Chief—Over 25 years on airplane design, accessories development, operations engineering, technical writing, and executive work. Wide experience with all types of materials; inventive and possessing initiative. Recent salary $7,500, but will consider proposition. Eastern part of U.S. preferred but not essential. Address inquiries to Box 372, Institute of the Aeronautical Sciences.

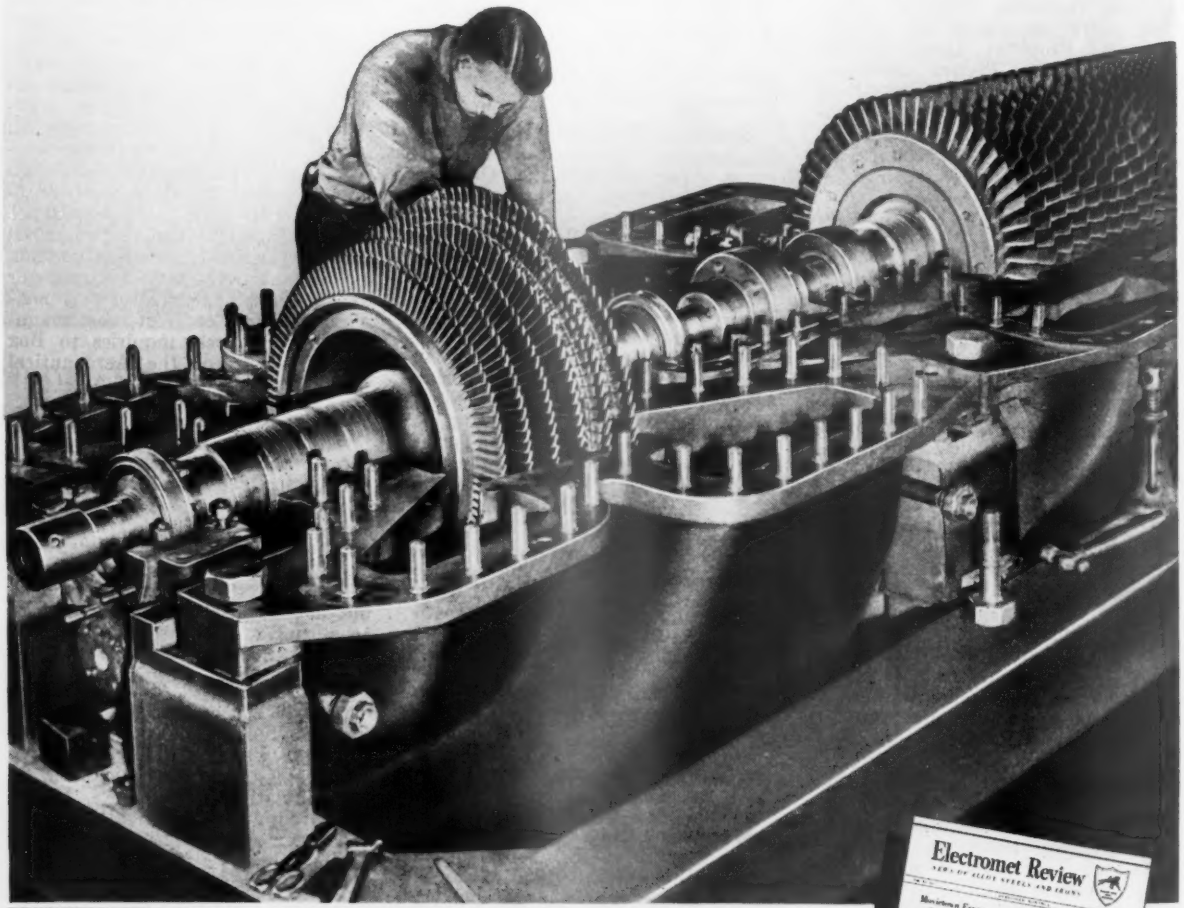
Director of Flight Training—Ranking Naval Officer available soon, desires position as Director of Flight Training Program for progressive University. Ten years' teaching, 24 years' aviation. Mechanics, Flight, and Ground Instructor ratings. Organization and operating experience. Address inquiries to Box 368, Institute of the Aeronautical Sciences.

Air-Line Service Engineer—B.S. in Aero. Eng. Over five years with major air line specializing in service problems on some trainers and most types of air transport aircraft. Experienced in troubleshooting, establishing service procedures, etc. Has supervised engineering projects. Desires similar position with small air line or aircraft manufacturer. Address inquiries to Box 367, Institute of the Aeronautical Sciences.

STAINLESS STEEL "*fire-eater*"

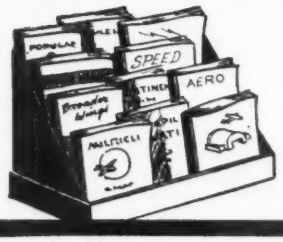
Engineers have long dreamed of building gas turbines, but, only recently have they had heat-resisting stainless steels that could stand up under the terrific heat and corrosive action of the flaming gases. The successful operation of stainless steel gas turbines, like the one pictured below, shows that these machines are now a practical power source for many industries.

While stainless steel is essential in gas turbines, there are many less severe applications in industry where this tough, heat-enduring metal also means longer life, fewer shut-downs, and more economical operation.



Other uses of stainless steel are described in ELECTROMET REVIEW, published by ELECTRO METALLURGICAL COMPANY, a Unit of UNION CARBIDE AND CARBON CORPORATION. ELECTROMET does not make steel, but produces the ferro-alloys used in its manufacture. If you need this complimentary publication, write to ELECTRO METALLURGICAL COMPANY, 30 East 42nd Street, New York 17, N. Y.

P-17930



Periodicals

Accessories and Equipment

Friction Brake Linings, Types, Uses, and Design Data. The various types of brake lining are classified and briefly described. Some of their applications, including those for aircraft, are mentioned. Advice is supplied about the use of coefficients of friction, brake-band or drum temperatures, and wear data in selecting a lining during the designing of brakes. *Product Engineering*, January, 1946, pages 39–43, 9 illus.

Swift Synchromo Control Assister. A study of the purpose, design, operation, and advantages of electrical assisters for the rudder, aileron, and throttle controls of the Short Shetland. Two forms of the Swift Synchromo control assisters are described—the "feel" type, in which the load applied by the assister motor is directly proportional to the load applied by the pilot; and the "irreversible" type, in which the load applied by the assister motor is independent of the pilot's control load. Particulars are submitted under topical headings of rack-type flying control assister; contactor gear mechanism; assister motor and "feel" mechanism; safety precautions; the irreversible assister; remote control unit; d.c. to a.c. conversion; small size unit. Schematic drawings of the devices are included with the illustrations. *The Aeroplane*, January 4, 1946, pages 24–26, 4 illus.

Aerodynamics

Effective Control of Stalling Characteristics of Highly Tapered and Swept-Back Wings. Maurice A. Garbell. A tested new method of airfoil selection is conceived to assist the designer in overcoming present hazardous stalling tendencies on highly tapered (3:1 or more) and swept-back (15° or more) wings, and to control stall at inception and through progression. This practicable method eliminates high drag penalties and other undesirable characteristics that develop with washout and highly cambered wing tips when employing two controlled sections.

Three controlled sections, one located at the wing root, another at a mid-span station, and the third at the wing tip, are connected by straight lines. The principal parameters affecting the maximum section lift coefficient, viz., the section thickness ratio and camber, are chosen to satisfy the section lift coefficients required by the computed span-load distribution at the Reynolds Numbers of the three spanwise control stations.

The resulting spanwise distribution of maximum lift coefficients permits the designer to exercise close control over the progression of the stall from its inception and thus reduce washout and camber variation to a minimum. A small but appreciable increase in maximum wing lift coefficients is also obtained. *Journal of the Aeronautical Sciences*, February, 1946, pages 88–94, 12 illus.

Airfoil Development and Structure Within the Cambered Surface. Part III. Roy A. Liming. The third section of a serial article continues the emphasis upon the versatility of the "direction number" concept of analytic geometry in the approach to problems involved in the calculation of the cambered surface and internal structure of the airplane. The writer begins with an explanation of the method of "rigging" the wing-reference plane system through the dihedral angle as a single angle of rotation, and reviews briefly the analytic technique governing the rotation of axes in the plane. The equations are arranged in tabular form, by which the coordinates of a point can be transformed directly from one reference system to another by employing direction numbers. The principle is applied to the development of the "rigged" slope-intercept equation pattern by rotation of the direction numbers, and the essential steps in the analytic derivation of the "rigged" equations are explained. It is shown that, by the use of automatic electric calculating machines, figures can be tabulated to represent a true view of the vertical wing stations in the fuselage plane of symmetry, and vertical wing sections may be calculated by direct substitutions. Specific advantages attributed to this analytic procedure include speed, accuracy, convenience, and flexibility. *Aero Digest*, January, 1946, pages 56–58, 130, 3 illus.

On the Stability of Two-Dimensional Parallel Flows. Part III. C. C. Lin. The concluding installment of a three-part article on two-dimensional parallel flow. It is stated that the results of investigations of the characteristics of a parallel flow in an inviscid fluid can be used as a guide in studying the stability problem in a real fluid, since instability is expected to occur only for sufficiently large Reynolds Numbers. Thus, if the general characteristics of

INDEX

Accessories and Equipment.... 77
Aerodynamics..... 77
Air Cargo..... 79
Air Power..... 79
Air Transport..... 79
Airplane Descriptions..... 81
Airports and Airfields..... 83
Armament..... 85
Avigation..... 85
Business and Finance..... 85
Civil Aviation..... 86
Control Equipment..... 86
Design..... 87
Education..... 87
Electrical Equipment..... 87
Engines..... 89
Flight Technique..... 91
Flight Testing..... 91
Fuels..... 91
Gliding and Soaring..... 91
History..... 91
Inspection..... 93
Instrument Flying..... 93
Lighter-Than-Air..... 93
Lubrication..... 93
Maintenance..... 93
Management..... 93
Marketing..... 95
Materials..... 95
Medicine..... 95
Merchandising..... 97
Meteorology..... 97
Model Airplanes..... 97
Naval Aviation..... 97
Paints and Coatings..... 97
Personalities..... 99
Personnel..... 99
Private Flying..... 99
Production..... 101
Propellers..... 102
Radio..... 102
Reaction Propulsion..... 103
Reconversion..... 105
Research..... 105
Rotating Wing Aircraft..... 107
Standardization..... 107
Stress Analysis..... 107
Superchargers..... 108
Testing..... 108
Testing Equipment..... 108
Tools and Equipment..... 108
Training..... 108
Welding..... 109

Start RIGHT AND YOU End RIGHT!

with WESTONS ON ALL PRODUCTION TEST-STANDS AND INSPECTION EQUIPMENT!

With the race for markets in full swing, electrical manufacturers are eliminating costly production bottlenecks by providing *uniform dependability* in testing procedure all along the line. From the inspection of purchased components right through to final product inspection, they insure accurate testing by using instruments they can trust.

And it's easy to insure *measurement dependability* at every step, because there are WESTONS for every testing need . . . including types for all special test-stand requirements, as well as a broad line of multi-range, multi-purpose test instruments. These compact, multi-purpose testers often afford new simplicity and economies in testing procedure, while assuring the dependability for which WESTONS are renowned.

Literature describing the complete line of WESTON panel and test instruments is freely offered . . . Weston Electrical Instrument Corporation, 687 Frelinghuysen Avenue, Newark 5, New Jersey.

Weston Instruments

ALBANY • ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • LOS ANGELES • MERIDEN MINNEAPOLIS • NEWARK • NEW ORLEANS • NEW YORK • PHILADELPHIA • PHOENIX • PITTSBURGH • ROCHESTER • SAN FRANCISCO • SEATTLE • ST. LOUIS • SYRACUSE In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.

"inviscid stability" for a given velocity distribution are known, some stability characteristics in a real fluid can be obtained by a modification of these results by the effects of viscosity. Such a consideration of the subject was made by Hersenberg but certain points required further examination. Because of this, the writer studies the problem in considerable detail. *Quarterly of Applied Mathematics*, January, 1946, pages 277–301, 3 illus.

Air Cargo

Air Cargo Possibilities. John H. Frederick. An analysis is made of the recent survey of future air-cargo possibilities conducted by Air Cargo, Inc., a group research project originally organized by several of the larger air lines. Field surveys with personal interviews were conducted in some 30 major market areas in the United States for the purpose of compiling data about shipping and distribution practices among selected groups of representative manufacturers, wholesalers, and retailers, as well as certain service and financial organizations. The object of the survey was to attempt to determine the industries in each market area which would most widely use air cargo as a method for future distribution. The analysis indicates that the apparel industry probably will be the largest user of air transportation, the machinery trade the second largest, and the motor-vehicle industry the third largest. It also indicates that air-line passenger services and equipment have far outdistanced the promotion of air cargo to the shipping public. *Distribution Age*, January, 1946, pages 46, 76, 78.

Mail Order by Air? Paul W. Brown. An official of a mail-order house makes an appraisal of air freight and discusses its future. To illustrate the importance of transportation costs to the mail-order industry, a comparison is made of rates on dry goods and clothing shipped by air freight, rail express, and rail freight. The importance of keeping air-freight rate schedules as simple as possible is emphasized. It is stated that a sliding scale of volume rates should be published to encourage the consolidation of small shipments into larger units that may be handled more economically. *Air Transportation*, January, 1946, pages 23, 24, 70.

Freight Handling. Patrick Macartney. The importance of improving freight handling methods in order to reduce air-transport costs is discussed. The article investigates several possible means for doing so—these include adoption of the "double-deck" idea; complete separation of passenger services from freight and baggage; developments in mechanical loading methods; improved design of baggage and freight trucks; properly constructed loading bays; prepacked containers; detachable fuselages; and improved stacking methods. *The Aeroplane*, January 4, 1946, pages 23, 24, 2 illus.

Air Power

The Nature of Air Power. Part I—The Military View. Gen. H. H. Arnold. **Part II—A Civil Commentary.** L. Welch Pogue. Appraisals of air power are given—from the military point of view by the former Commanding General of the Army Air Forces; from the civilian point of view by the Chairman of the Civil Aeronautics Board.

General Arnold states that the most important contribution of the A.A.F. to the winning of the war was the application of the concept of strategic bombing to destruction of the enemy's ability and will to resist the assaults of the Allied forces. He emphasizes the lack of preparedness on the part of the United States, crediting the bravery and sacrifices of our Allies with giving us time to build up our military establishments for air and surface warfare, but he warns that in the event of another war we will not be given such an opportunity to prepare. He states that the new air weapons and instruments make air power of the utmost importance in the national security and that there must be no relaxation of the effort to keep ahead in research and manufacturing facilities in the aircraft industry. He concludes that in order to maintain peace our purpose must be to make our air power so strong that we will never need to use it.

The Chairman of the Civil Aeronautics Board reviews the contributions of civil aviation to the development and maintenance of air power, stating that prewar concepts of the relationship of civil aviation to air power are now obsolete. His thesis is that the trend of future military air power in offensive action is so definitely in the direction of the rocket and the guided missile that civil aviation will grow farther away from direct relationship to military air power and that its future contributions will be in the form of transportation. He urges that civil and military aviation be kept separate in all matters of policy formulation and administration, and opposes the granting to the military authorities of decisive powers in the development and control of civil aviation, although holding that they should always be heard in an advisory capacity relative to the national defense. The great progress of civil aviation in the United States is attributed to its freedom from hampering governmental restriction and domination, the writer believing that our civil aviation will continue to maintain its excellence if it remains free and does not become a "captive" of military principles. *National Aeronautics*, December, 1945, pages 18–23, 6 illus.

Air Transport

Private Enterprise Fights to Keep Flying. H. Bowden Fletcher. The position taken by Australian private-enterprise air lines against the Australian air-line nationalization bill is indicated by answers to eleven key questions. The reported answers are those of the chief executive officer of the private operators' secretariat. The questions asked were: (1) Has it been the Commonwealth's intention to nationalize all air lines? (2) Was nationalization proposed because of any inefficiency in "interstate air-line" operations? (3) Was nationalization proposed because of a weighty subsidization of the interstate air lines, making their operations a charge upon the taxpayer? (4) You claim the air lines return a profit to the Government. How? (5) Since the Government has, as it says, spent millions in provision of civil aviation facilities, is it not right that the Government should run the air lines rather than allow a few private operators to have the benefit of this expenditure? (6) Should not the Government own the air lines because of their strategic importance and the necessity for their development for defense purposes? (7) As development of the interior is essential and as private air lines, which are profit-motivated, cannot be expected to fly nonprofitable routes, is not this sufficient reason for Government ownership? (8) As transport is a public utility, would you agree that some Government control of air transport is necessary? (9) Will the air lines contest the legislation? (10) How will the air-line operators contest the legislation? (11) Assuming the legislation is declared valid, does its implementation follow as a matter of course? *Aviation*, January, 1946, pages 40, 41, 190, 192, 195, 196.

The Future of World Airlines: South America. Lucien Zacharoff. The commercial aviation potentialities of South America are considered in the tenth of a series of articles on the outlook for world air lines. The history of civil aviation in the various South American countries is reviewed and imformation is supplied about future plans of the air lines. How transportation problems of climate and topography have stimulated the expansion of air lines is described. *Air Trails*, February, 1946, pages 32, 33, 91, 92, 94, 96, 98, 100, 102, 104, 5 illus.

IATA—League of Airlines. John C. Cooper. A summary of the history of the International Air Transport Association includes an enumeration of the aims and objects of the organization, as set forth at the Havana conference in April, 1945. Particulars are given about the plan of the organization as recommended to, and adopted by, the conference. The relationship of the Provisional International Civil Aviation Organization is outlined and the functions of that organization are described. The officers of the International Air Transport Association and the committees and their duties are

AS the draftsman's pencil makes its mark, he issues orders, through a remarkable kind of shorthand, to the men who must act on his drawings. But only with special assistance can human hands shape such precise, complex orders as these. No wonder the draftsman chooses his instruments with care . . . he is, in effect, taking them into partnership!

In this sense, Keuffel & Esser Co. drafting equipment and materials have been the draftsman's partners for 78 years in creating the peaceful culture and wartime might of America, in making possible our concrete dams, steel bridges, aluminum bombers.

partners in creating

...the world's highest dams

....longest bridges

....fastest airplanes

So universally is this equipment used, it is self-evident that every engineering project of any magnitude has been built with the help of K&E. Could you wish surer guidance than this in the selection of your "drafting partners"?

Especially in these hurried days, you will find a PARAGON* Drafting Machine a boon to your work ...and your nerves! With the finger tips of your left hand on its control ring, the lightest pressure enables you to set the scales at any angle, anywhere on the board. Your right hand is always free. For the full PARAGON* story, write on your letterhead to Keuffel & Esser Co., Hoboken, N. J. *Reg. U. S. Pat. Off.

K+E

Drafting, Reproduction, Surveying Equipment and Materials. Slide Rules, Measuring Tapes.

KEUFFEL & ESSER CO.
EST 1867
NEW YORK • HOBOKEN, N. J.
CHICAGO • ST. LOUIS • DETROIT • SAN FRANCISCO
LOS ANGELES • MONTREAL

listed. *Air Transport*, January, 1946, pages 29–33, 6 illus.

Airlines of America. Robert Craig. The history of each of the leading air lines of the United States is reviewed briefly, with comments concerning the origin and antecedents of the companies, the men who controlled them, and the communities they serve. The early names of the lines and the processes of reorganization and merger by which they have arrived at their present positions are traced, showing how they grew and expanded their routes. *Air News*, January, 1946, pages 28, 29, 34, 35, 70, 73, 4 illus.

Local Airlines. Kurt Rand. Interpreting the importance of C.A.B. certification and decisions to the existence of such services, the writer surveys the operations of several "local" air lines, including both intrastate and interstate air carriers. The information he imparts includes data pertaining to their routes, schedules, record, prospects, equipment, rates, and problems. Among the air lines mentioned are Bluegrass Airlines, Zimmerly Airlines, Otto Airlines, Ozark Airlines, Summit Airways, Ray Wilson, Inc., Michigan Central Airlines, E. W. Wiggins, Inc., Trans-Marine Airlines, Maryland Airlines, Essair, and All-American Airlines. The types of service offered by these air lines are divided into four categories: scheduled operation; nonscheduled—regular; nonscheduled—irregular; and charter. *Flying*, February, 1946, pages 30–32, 134, 4 illus.

More Passengers—Less Fuel in AA's Unconventional DC-3's. John T. Fisher. The writer explains how American Airlines converted DC-3 airplane to provide efficient transportation on short-haul flights. Seven additional seats were added. A plan of seven rows of four seats was chosen. The seating arrangement was begun one row ahead of where it normally starts in the conventional 21-passenger arrangement, so that luggage racks could be installed to give better service to the passenger and reduce ground handling costs of baggage. Other changes that were made are described. Plastics were used for walls and floors to reduce weight and maintenance costs. *Air Transport*, January, 1946, pages 55, 56,.59, 7 illus.

The Battle of Transportation. John Forney Rudy. Various phases of the struggle for supremacy between air and surface carriers are discussed. Graphs show the per cent growth in passenger-miles for air lines, railroads, and passenger buses from 1930 to 1941 and the number of passengers carried by American-flag steamships and air lines over the same period. *Air Trails*, February, 1946, pages 24, 25, 112–116, 3 illus.

It's a Small World. John Paul Andrews. The development of the international air lines is traced. After reviewing briefly the diplomatic and political aspects of international agreements for the establishment and operation of air lines serving foreign countries, the writer relates how the Pan American Airways organization was built up, the extent of its territory, and the character of its services. Figures are quoted with regard to its route mileage and earnings, and a forecast is made of its future operations. In a similar manner, the growth of the foreign services of American Airlines is recounted, as well as that of Transcontinental & Western Air, Braniff Airways, and Northwest Airlines. Shorter sketches are presented about the companies domiciled in countries outside the United States, including those of Swedish, Irish, British, Czechoslovakian, Chinese, Mexican, Danish, Norwegian, Brazilian, Cuban, Indian, Belgian, Australian, Swiss, and other nationalities. *Air News*, January, 1946, pages 37–40, 45, 75, 76, 78, 11 illus.

Airplane Descriptions

One for the Japs. G. E. McCadden. Specifications of a long-range Japanese reconnaissance airplane which flew 10,160 miles nonstop in 57 hours 1 min. are supplied. The information includes an account of the record flight. Called the A-26, the plane is described as a flying gasoline tank because it has no fuselage tanks and its 9-ton gasoline load is carried in tanks which extend along 75 per cent of the wing span. The reported top speed for the A-26 is 285 m.p.h., and its cruising speed is 190 m.p.h. at 6,000 m. *Western Flying*, January, 1946, pages 28, 29, 58, 5 illus.

Two of a Trio. The design, construction, and performance of two Bristol airplanes developed from the basic Blenheim-Beaufighter design are described. Schematic drawings and photographs are included. The first aircraft is the type 163 Buckingham, cited as a fast day or night bomber; the second is the type 164 Brigand, a long-range attack monoplane. Structural similarities between the successive Bristol types are indicated, as well as the few structural differences between the Buckingham and the Brigand. The article includes tables of essential data for the Buckingham (B)1, Buckingham (C)1, and the Brigand. *Flight*, December 13, 1945, pages 623–625, 630, 6 illus.; "Buckingham and Brigand," *The Aeroplane*, December 14, 1945, pages 689–693, 5 illus.

The Noury Noranda. The information in this article pertains to a Canadian design for a tandem trainer. The Noranda is reported to be a conventional high-wing, strut-braced monoplane with a 65-hp. Continental engine. Of mixed construction, it has a welded steel tube fuselage and empennage, wood in the wings, and fabric covering on all surfaces. Maximum speed is placed at 110 m.p.h., cruising speed at 95 m.p.h., and cruising range at 400 miles. The price for the trainer is expected to be around $2,400. *Canadian Aviation*, January, 1946, pages 27, 34, 58, 4 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Flying the Howard. A. H. Knouff. Intended primarily for those planning to purchase surplus Navy models, advice is offered regarding the handling and flying characteristics of the Howard DGA. Differentiation is made between the peculiarities of the four varieties of the airplane: The GH-1, NH-1, GH-2, and GH-3. It is the writer's opinion that, while the DGA is definitely not an airplane for students, experienced private pilots should find it convenient, comfortable, and economical. *Southern Flight*, January, 1946, pages 40, 41, 46, 1 illus.

Short Seaford. Following an examination of the flying boat's antecedents, distinguishing features of the Short Seaford are indicated. The Seaford is described as a civil development of the Sunderland with good economical performance. The major portion of the article refers to the internal accommodations of the transport. Charts, illustrations, and tables supplement the descriptive data. *Flight*, January 3, 1946, pages 8–10, 10 illus; "The Short Seaford Flying-Boat," *The Aeroplane*, January 4, 1946, pages 27–29, 5 illus.

New . . . on the Wing. Illustrations accompany the brief descriptive data in this compendium of new airplanes. The aircraft reviewed include the Douglas XB-42, Bowlus Bumblebee, Boeing XF8B-1, All American Ensign, Airspeed Ambassador, Roteron helicopter, Beechcraft XA-38, Tennessee Aircraft Skyfarer, Taylorcraft Auster, DeHavilland Hornet, and Funk Bee. *Skyways*, February, 1946, pages 54, 55, 87, 15 illus.

The Folland E.28/40. An illustrated study is made of a projected British design for a single-engined torpedo reconnaissance bomber. The specification to which the plane was designed by Folland Aircraft, Ltd., was E.28/40, calling for a crew of three, torpedo bombs, power-operated gun turret, full navigation and night-flying equipment, the usual pyrotechnics, arrester gear for deck landing, a range of 800 miles, and a single Bristol Centaurus III engine. The high-wing all-metal monoplane that resulted had as its most unusual feature the carrying of its wing in trunnions so that the angle

Just a gentle, gigantic squeeze!—and presto! ...a new shape for an old!

Just put a tube in that heavy hydraulic press. There it is held fast in a die while a specially shaped plunger is driven into or over the end and the tube is expanded to the desired shape.

That is another PRECISION job in tube-bending.

Any job of tube-bending; from a tiny ⅛ inch oil line to a five-inch exhaust; all complicated tubular parts or assemblies; any problem of reducing, flanging, expanding, flaring, beading, swazing, brazing, or welding of tubes—THAT is *our* job! And it calls for exacting PRECISION.

If you need this kind of exceptional skill and reliability, put your tube-bending problems up to us.

Write for informative booklet, "Precision in Tube Bending," to the American Tube Bending Company, Inc.,A1Lawrence St., New Haven (11), Conn.

AMERICAN TUBE BENDING COMPANY, INC.

PRECISION to aircraft standards

of incidence could be varied from 4° to 79°. It is reported that stoppage of work on the E.28/40 in 1943 was caused by a change in Air Ministry policy. *Flight*, January 3, 1946, pages 14, 15, 4 illus.; "The Folland Tradition," *The Aeroplane*, January 4, 1946, pages 12–14, 7 illus.

The Portsmouth Aviation Aerocar. Three models of the Aerocar series are surveyed: the Major, Minor, and Junior. Manufactured by Portsmouth Aviation Ltd., the Aerocar is a twin-engined light transport airplane designed for the charter and air-taxi operator, the small feeder air line, the business executive's personal plane, the hire-and-fly-yourself operator. The Major has two 150-hp. engines; the Minor and Junior, two 100-hp. engines each. While the Major and Junior carry six passengers each, including the pilot, the Minor provides accommodations for only five. Weights, dimensions, and performance figures are included for all three of the models. *Canadian Aviation*, January, 1946, page 36, 1 illus.

Experimental Lightplane Under Test by Bendix; Price of $2,500 Is Goal. Alexander McSurely. A new experimental personal-type airplane that the Bendix Aviation Corporation hopes eventually to be able to market for about $2,500 is described. It is a three-place, all-metal monoplane of the low-wing type with a retractable tricycle landing gear, and it is stated to have excellent take-off performance, a slow landing speed, and superior vision range. Reference is made to test flights conducted at Windsor, Canada, which revealed that the plane has an unusually wide speed range. *Aviation News*, January 28, 1946, pages 27, 28.

The Reid and Sigrist Desford. Flight Lieutenant D. A. S. McKay. A description of the Reid & Sigrist Desford, a modified version of the twin-engined trainer airplane, Snargasher, which was conceived in 1939. Following general design, construction, and performance data about the two-seater Desford, features of its various components are reviewed and impressions are given regarding its flying qualities. Differences between the Desford and its predecessor are indicated, while dimensions, weight, loading, power plant, and performance figures are listed for the new plane. *The Aeroplane*, December 28, 1945, pages 751–753, 5 illus.

Airports and Airfields

What's Wrong with Our Air Terminals? Marc Thompson. Based on a national survey made for the Civil Aeronautics Administration, an analysis is made of the key factors in planning future airports. The article outlines the extent of this problem and sketches a complete program of planning principles suited to the airport needs of the future. Decisive factors in an adequate airport plan are examined separately. Choice of proper location; a plan made for the airport's maximum development as well as for immediate construction; the design for optimum usefulness of apron; administrative area; concourse and terminal group; and the location of offices and express facilities are discussed and illustrated. The writer urges that, before any air terminal is planned or even a site for one considered, the services of a competent architect be obtained. The site for the terminal airport must contain sufficient building area and must have proper location in relation to the city. In many cases today where an airport is incapable of handling increased traffic, it is admitted that the fault lies in the inadequate buildings and not the runways.

Other portions of the report refer to such possibilities as a hotel incorporated in the administrative area, the erection of proper concourses and passageways, and a discussion of the various types of concessions and services that might profitably be included. A special plan for small community terminal buildings is offered. *The Architectural Forum*, January, 1946, pages 123–128, 130, 132, 134, 31 illus.

Types of Asphalt Surfacing. George H. Dent. It is explained that asphalt or flexible pavements may be designed for any type of airport and that types of asphalt surfacing vary all the way from a "dust layer" or palliative up to the high-grade asphaltic concrete found on many of the world's great airfields. The composition of the various types of asphalt surfacing and the conditions under which each is suitable are examined. Sections of the article are devoted to palliatives, asphaltic surface treatment, the mixed-in-place type of pavement, penetration macadam, and plant mixes. *Airports*, January, 1946, pages 21–23, 9 illus.

Mobile Dual Refueler Affords High-Rate Service. Thomas H. McConnell, Jr. The Intava Servicer, a self-propelled unit for refueling aircraft, is described. It incorporates two complete pumping systems, each with discharge hose capable of transferring 150 gal. per min. and takes on fuel by means of a suction hose connected to hydrant valves at convenient points in a system of underground piping. A hydraulically operated telescopic lift for elevating the operating crew to wing level has a 4-ft. platform and is extensible to 15 ft. The unit is intended to eliminate (1) the disadvantages occasioned in servicing only a single large aircraft at one time; (2) the necessity of returning the refueling unit to a central filling station to take on additional fuel. Features of the unit are depicted in a schematic drawing. *Aviation*, January, 1946, pages 105, 190, 2 illus.

Sales Methods in Aviation Gas. J. Kirk Baldwin. Methods of selling aviation gasoline at municipal airports are discussed. The profits that should be realized, the number of brands to carry, various sales problems, and objections to the municipal operation of gasoline concessions are considered. *Airports*, January, 1946, pages 51, 52.

Missouri Goes to Work! Frank Maher. The extensive airport expansion program that has been launched by the state of Missouri is discussed. The article describes what Missouri cities are doing to secure adequate landing facilities and promote aviation. *Airports*, January, 1946, pages 26, 27, 56, 58, 7 illus.

Skyborne Freight and New York's New Airport. Emery F. Johnson. It is stated that the bright outlook for air-cargo transport has become an integral part of commercial aviation. The role New York's Idlewild airport will play in future air commerce is forecast. *Air Transportation*, December, 1945, pages 17, 18, 21, 22, 5 illus.

Why Some Airport Lighting Fails. L. C. Vipond. Causes of airport lighting system failures are analyzed. Suggestions are made regarding maintenance practice that will aid in the prevention of such failures. Emphasis is placed on the importance of employing an experienced electrician who has a practical knowledge of high voltage and series street-type lighting systems. *Airports*, January, 1946, pages 28–30, 69, 4 illus.

Uniform Rates for Airport Rental Space. John H. Frederick. Standards are cited for rental of airport ground areas. In addition to uniform rates for rental of space, it is stated that leases that provide for the construction of a building by the lessee should be made subject to construction standards applicable in the community and that the leases should provide for minimum maintenance standards for both buildings and grounds. Provisions are suggested which should be included in leases with regard to location, size, trim, rent, privileges, building, insurance, and restrictions. Factors to be considered in arriving at an annual rental figure are listed. *Southern Flight*, January, 1946, pages 54, 59.

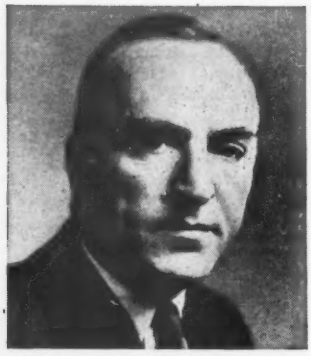
$5000 Can Start an Airport. Russ Brinkley. The procedure for starting a small airport on a limited capita is outlined briefly. Advice about Civil Air Regulations, choosing a site, airport building, flying equipment, financing agencies, and charges for service is offered. A case is cited where one operator carried out his own business for a 12-month period with an investment of $5,000. *Airports*, January, 1946, pages 42, 43, 62, 3 illus.

Presenting Skytel. Lathrop Douglass. The first of a series of projected plans for Skytels of varying costs offers sketches and suggestions for a Skytel in the $25,000 class. A form of field-side hotel for personal-plane fliers, Skytels are small airports where planes can be refueled and pilot and passengers fed and housed overnight.

What Airline Executives Say About the New Martin Transports

C. Bedell Monro, *President*
Pennsylvania-Central Airlines

". . . will curtail ground time, reduce operating and maintenance costs, offer new comforts and safety and ultimately pave the way for lower fares."



Capt. Eddie Rickenbacker, *President and General Manager*, Eastern Air Lines

"Our engineers have made a long and close study of planes being offered for near-term deliveries by manufacturers and they concluded that Martin had designed the best of its class."

Carleton Putnam, *President*
Chicago and Southern Air Lines

". . . the perfect airplane for our type of operation. Delivery of the Martin 202 in 1947 will enable us to replace the DC3 with 5 mile a minute air service between our trunk line cities."

T. E. Braniff, *President*
Braniff Airways

"Continuing our policy of maintaining the best and latest equipment available to a commercial airline, we purchased Martin transports after long and thorough study of all entries in the 30-40 passenger plane field."

W. A. Patterson, *President*
United Air Lines

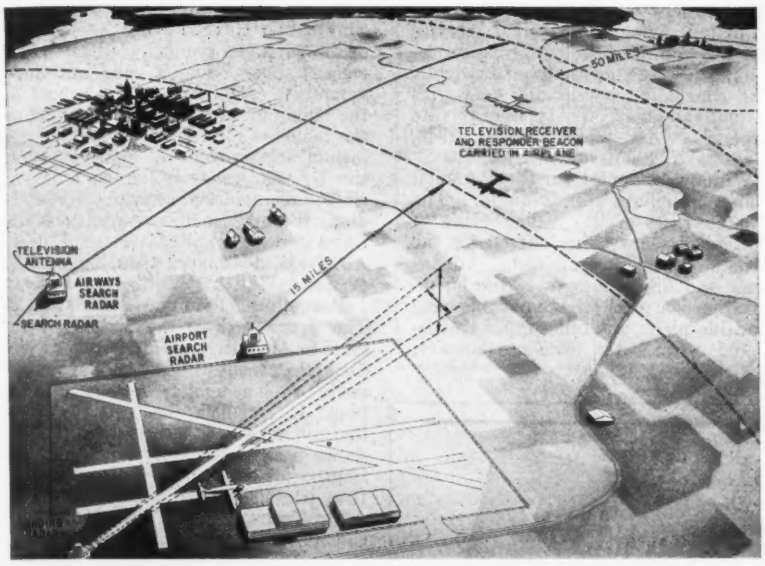
". . . will round out our equipment picture providing the same comfort and speed advantages in inter-city service as will be offered by our four-engined Mainliners on through, long-distance flights."

Experts agree that the nation's travelers will have the world's finest air transportation when they fly via Martin Airliner!

THE GLENN L. MARTIN COMPANY, BALTIMORE 3, MARYLAND.

Martin
AIRCRAFT

Builders of Dependable Aircraft Since 1909



The scope of Teleran, a proposal of the Radio Corporation of America to combine television and radar for air navigation, is shown in the above illustration. Three radar and television installations could be used for range, approach, and localizing. By adding radar units between airports the system could be extended for en route navigation.

The article explains the value of such facilities to the individual air traveler, as well as to private flying in general. It answers such questions as who, specifically, would patronize skytels; where they should be built; who would feel it worthwhile to build one; and how much a skytel would cost. A budget is included for establishing and operating a skytel. Preliminary steps to be taken when preparing to build such a project are outlined. *Skyways*, February, 1946, pages 44–49, 92, 94, 8 illus.

A Tool for Traffic Control—Teleran. A proposal of the Radio Corporation of America to combine television and radar for air-traffic control is explained. Reference is made to components proposed for Teleran (Television-Radar Air Navigation). It is stated that the equipment seems to offer a means of creating a traffic-control system to aid navigation on all domestic airways. Features of the proposed system are described and illustrated. *Air Transport*, January, 1946, pages 73, 74, 77, 78, 5 illus.; "'Teleran' for Air Traffic Control," by Raymond LeKashman, *Aero Digest*, January, 1946, pages 82–84, 5 illus.

Selling Lightplane Navigation. Alan Goldman. It is emphasized that airports should give attention to the profits that can be realized through the sale of navigation equipment. One suggestion is that sales could be increased by the display of maps, charts, and other navigation aids for the lightplane operator. *Airports*, January, 1946, pages 45, 46, 2 illus.

Preventing Ghost Towns of the Air. Robert W. F. Schmidt. The thesis of this article is that failure to provide adequate airport facilities may cause the economic death of a community. In advising how to avert the possibility of such a catastrophe, the writer explains the value of having the airport well located with respect to lines of flight, attractive, and efficiently operated. *Western Flying*, January, 1946, pages 38, 39, 54.

Key to Mass Air Travel. M. F. Redfern. It is pointed out that New York's Idlewild airport will be a great testing field for developing and testing air traffic. How knowledge gained from the operation of Idlewild may increase the efficiency of air-line ground operations is described. It is stated that the airport will provide the opportunity to test timesaving methods of landing, taking off, loading, and unloading. Technologic advances in radio, radar, and electronics will be put to the severest tests, and their application to large-volume traffic will be demonstrated. Improvements in station facilities, such as loading decks designed to speed the movement of passengers, turntables, and new methods on the taxiways, are other means that will be used to solve ground-operation problems. *Air Transportation*, December, 1945, pages 11–14, 16, 5 illus.

Increase Your Airport Profits. Arthur S. Brown. Possible sources of revenue for the airport operator are discussed. It is stated that the more important of these include the sale of new and used airplanes, the sale of oil and gasoline, servicing airplanes, storing airplanes, flight instruction, the sale of aircraft accessories and parts, the sale of food, and the renting of lodgings. Ways of obtaining full profit from such sales are suggested. *Airports*, January, 1946, pages 49, 50, 1 illus.

Armament

Aircraft Armament. Lt. Col. George C. Gentry. The recent history and development of armament for aircraft are briefly reviewed. The program inaugurated in 1935 by the Chief of Ordnance and the Commanding General of the Army Air Forces is outlined, with descriptions of the progress made in designing and producing 20-mm. machine guns, the 37-mm. aircraft cannon, and the 75-mm. aircraft cannon. The technique of transporting guns and ammunition in airplanes and dropping them by parachute to the ground forces is outlined. *Journal of Applied Physics*, December, 1945, pages 771–773, 4 illus.

Boulton Paul 0.50-in. Gun Turrets. Two types of Boulton Paul 0.50-in. gun turrets are detailed—the "D" type and the "F" type. Although designed for use in the Handley Page Halifax, these turrets are reportedly used in tail and nose positions in the Avro Lincoln. They are similar in basic principles to the 0.303-in. gun turrets but differ in structural detail and incorporate several improvements. *The Aeroplane*, January 4, 1946, pages 14, 15, 5 illus.

Avigation

Navigation Help Wanted. Lt. Jerome S. Hardy. An analysis of 153 major aircraft accidents in the A.A.F. attributed to navigational causes is used to show that there is an even more urgent need for additional navigational aids for private pilots. New navigational literature, an adequate system of ground markings, reliable weather information obtainable at small airfields, and easy-to-read maps are among the immediate aids recommended. *Air Facts*, February, 1946, pages 17–20.

Loran. Nathaniel F. Silsbee. The nature, operation, applications, and advantages of Long Range Navigation are explained. In addition, the record of this radio navigation system's use by the Allies during the war is outlined, and its planned utilization for peacetime air transportation is noted. *Skyways*, February, 1946, pages 26, 27, 76, 78, 82, 20 illus.

Don't Get Lost. Norman C. Stoll. It is stated that the personal plane will not take the place of the automobile until civilian pilots learn some of the fundamentals of aerial navigation. Methods of pilotage are outlined in easily understood language, and instructions are offered concerning navigation instruments and their use. *American Helicopter*, January, 1946, pages 28, 29.

Business and Finance

Accounting for Aircraft Service and Maintenance. Todd Mumma. The article deals with accounting methods for "customer labor sales"—that is, labor charged to the customer—and for the cost of servicing the company's own equipment—that is, internal labor costs. The importance of attention to the cost of repairs on company equipment is emphasized. Samples of accounting records are described and illustrated. *Aviation Maintenance*, January, 1946, pages 26–29, 3 illus.

Civil Aviation

The Ideal Light Plane. Charles E. Bossi. The writer gives his opinions regarding the requirements for a light plane. Factors considered include performance, maneuverability and flight handling, size and power, cabin arrangement, equipment, and cost. *American Helicopter*, January, 1946, pages 42, 43, 2 illus.

Future of British Aviation. Sidney Veale. The progress of British aviation in reconverting from a war to a peace basis is reviewed briefly. The features of each of 20 new transport types are described, with information concerning their development and equipment. Specifications for these airplanes are tabulated, giving data about the service classification, engines, performance, accommodations, dimensions, and weights. The concluding paragraphs deal with current and prospective types of private airplanes. *Air World*, March, 1946, pages 21–25, 8 illus.

Window-Shopping for the Personal Plane. Richard G. Naugle. The characteristics of the various types of light planes now being offered for the civilian flier are examined. Advantages and disadvantages of the boom-tailed pusher plane, the removable-wing roadable plane, and other types are discussed. *U.S. Air Services*, January, 1946, pages 11, 12, 36.

The Further Adventures of Mr. Smith. Barbara S. Parker. Objections of the public on grounds of hazards, increased taxes, zoning, and nuisance values are established as hindrances to the building of local airports. Some of the remedies recommended for this objection are propaganda and education through newspaper columns, aviation clubs, and aviation activities for children through such organizations as the Air Scouts and Civil Air Patrol. *Air Facts*, February, 1946, pages 37–42.

Peacetime Pylons. Jack Stark The writer reviews the history of air races in America, showing the contributions that air carnivals and air races made to the general acceptance of aviation. He predicts the probable form that air races will take as a part of air shows designed to sell planes and air transportation. *Skyways*, January, 1946, pages 32, 33, 80, 82, 7 illus.

Air Transport in Transition. Alec E. Davis. In addition to a short review of Norwegian air transport during wartime, this article deals with the plans that have been laid for extending Norway's air lines in peacetime. The work of the state institution, Royal Norwegian Air Transport, is noted. Comments are made relative to external and internal air services, routes, equipment, air crews, and air terminals. *Flight*, December 20, 1945, page 663, 1 illus.

Control Equipment

Electro-Hydraulic Mechanism Control. William L. Lewis. Details are revealed of a system designed to regulate electrically the position of hydraulically actuated mechanical devices from a remote control point. The system, known as "HYdronic," was originally developed for operating aircraft landing-flap mechanisms but is not restricted to this particular application. A typical aircraft application is described. *Industrial Aviation*, January, 1946, pages 13, 14, 16, 63, 64, 5 illus.

Pulley Design for Modern Planes. R. R. Richolt. Seven criticisms of the AN210 specifications for aircraft pulleys are offered as a stimulant to constructive thinking and creative effort to overcome the difficulties that have arisen in the application of current pulley designs to the larger airplanes now being planned and built. It is stated that pulley design needs a complete revision in which a number of factors other than weight should be considered. Some of these factors come from the requirements of large airplanes, and others are applicable to any airplane regardless of size and arise from difficulties experienced on the production line. The seven points are as follows: (1) Hub widths and wobble clearances are insufficient; (2) bore sizes of bearings are too small; (3) friction and lubrication; (4) pulley diameters; (5) alignment provisions; (6) load ratings; (7) special pulleys. Specific criticisms are made of each of these, and suggestions are offered for improving the design, re-

A thoroughly dependable motor is the first step in meeting the high standards of performance that will be demanded of tomorrow's products. Backed by 30 years' experience and used successfully in over three thousand special applications, Lamb Electric motors may provide the answer to your motor problems.

THOROUGH ENGINEERING is the basic factor behind the successful operation of the special application motors shown here and many others we have designed and built for all types of equipment.

THE LAMB ELECTRIC COMPANY • KENT, OHIO

Lamb Electric
FORMERLY Black & Decker Electric
SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS

sulting in better operation and maintenance. *Aero Digest*, January, 1946, pages 54, 55, 129, 130, 3 illus.

Design

Design Requirements for Pickup Aircraft. Arthur B. Schultz. The theoretic principles of cargo pickup are outlined. The design of pickup units, contact means, transfer equipment, and ground stations for both 200-lb. and 60-lb. units are considered. The basic features desirable in future pickup airplanes, as well as structural design requirements, are also outlined. The writer then describes glider pickup, giving attention to the basic theory behind this type of pickup, the design of pickup units, their installation in the airplane, the cable guide system, and contact means. He reviews the design features of glider-pickup airplanes and structural design requirements to be used in the installation of the equipment. *SAE Journal*, January, 1946, pages 1–17 (Transactions), 24 illus.

Viewpoints: Which Is Better—Pusher or Tractor? The subject of pusher versus tractor aircraft propulsion is reviewed, and the opinions of proponents of each method of propulsion are summarized. *Air Trails*, February, 1946, page 29, 2 illus.

Stop Blaming the Pilot! Lt. Wilfred Owen. An analysis of the relation between pilot error and aircraft design. Based upon A.A.F. studies, the analysis shows that many accidents blamed on pilot error are preventable by improved airplane design. Among the specific improvements suggested are more scientific replacement of control switches, installation of adequate warning devices, and better vision range. *Flying*, February, 1946, pages 24, 25, 116, 4 illus.

Designing Tomorrow's Personal Plane. Part VII. Ralph H. Upson. So-called unconventional designs of wings and other airplane components are considered in the seventh section of a serial article. The construction and lifting ability of the monoplane type of wing are compared with those of biplanes and other multiple-wing types, comments being made about struts, slots, flaps, and other devices. Such "unorthodox" methods as filling the tires, the wing, and fuselage interiors with lifting gases are mentioned, it being concluded that auxiliary lift of that kind is feasible for large airplanes but is not practical at present for small craft of the personal type. The possibility of using various kinds of reaction units for propulsion or for added thrust for light airplanes is investigated, and another idea is the use of a separate rotor or rotating wing, driven by rockets or jets, for emergency use or for assistance in taking off and landing. The complications of such an arrangement are admitted, but the idea is offered as a possibility. Another way to increase the thrust for take-off is to shroud the propeller in a wide ring of suitable airfoil section, with which the beneficial effects are the reduction of tip loss and of slipstream contraction. End plates for wings are in a somewhat similar class. The merits and disadvantages of such devices are discussed. Noting that landing gears offer opportunities for improvement, the writer examines the question of how many wheels should be used, outlines present designs, and suggests that ultimately the entire weight and drag of the landing gear may be eliminated by providing landing and take-off mechanisms that can be left on the ground and not carried as parts of the airplane. *Aviation*, January, 1946, pages 84–88, 2 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Design Aspects of the Goodyear Model M. Airship. Karl Arnstein. Design features of what is termed the largest nonrigid airship are analyzed by the Vice-President in Charge of Engineering of the Goodyear Aircraft Corporation. It is observed that the Goodyear Model M was developed to meet the Navy's need for larger airships than the Model K to patrol the sea lanes. The Model M has a cruising speed of 50 knots and a range of 2,650 miles. Several design features never before used in nonrigid airships were incorporated in the Model M. Two engineering problems that had to be solved were the development of new and stronger fabrics to withstand increased envelope stresses and the development of an improved car-suspension system to distribute the loads more evenly over the length of the envelope. To provide an understanding of the nature of these problems, the stresses in nonrigid airship envelopes are explained. The writer describes the construction of the car section of the airship; the power plants, which consist of two 550-hp. Pratt & Whitney geared radial engines; and the electrical system. Photographs and drawings show the construction of the airship. *Industrial Aviation*, January, 1946, pages 7, 8, 10–12, 58, 8 illus.

Cockpit Classification. Flight Lieutenant Gordon White. A uniform system of cockpit layout for all types of aircraft, both civil and military, is suggested. The problem is approached by formulating a basic "theory" of cockpit controls and instruments, by applying this conception to theoretic and practical flying, and by the recommended manufacture of aircraft in conformity with the theory. Essentially, the plan consists of (1) classifying all instruments and controls into four main and two subsidiary groups; (2) requiring that all groups be learned progressively, with periodic examinations as part of flying training; (3) locating the four main groups in separate cockpit areas, with the location of these areas to be invariable for any type of aircraft, insofar as design permits: (4) binding each area by an appropriate colored border, so that a group may be recognizable immediately by its color. The routine of cockpit drill, cockpit layout, and necessary training for familiarity with the suggested cockpit arrangement are specified. The four main groups in which the instruments and controls are classified are flying, control, engine, and auxiliary. The two subsidiary groups are operational and radio. *Flight*, December 13, 1945, pages 630a–630d, 4 illus.

Slip-Wing Experiments. An account of experimental flight tests carried out with a standard Hawker Hurricane F. Mk. 1 fighter plane to which a slip-wing was fitted. Of two-spar wooden construction and covered with a plywood skin, the jettisonable wing was anchored to the fuselage of the fighter by tubular "N" struts attached to the front and rear spars, terminating at their lower extremities into forks that engaged the release gear. Diagonal struts were incorporated to prevent lateral movement, and an electrical solenoid gear was installed for operating the release. Advantages claimed for the slip-wing theory are that it obtains extra take-off qualities for the plane. *The Aeroplane*, December 14, 1945, page 697, 3 illus.

Education

Instructional Courses on Aero-Engines. Procedure for the establishment of a manufacturer's aircraft-engine school is suggested. The equipment required, the kind of premises needed, and problems concerning the instructional staff and examination papers are considered, and a suggested syllabus is included. *Aircraft Engineering*, December, 1945, pages 361, 362.

Objectives of a Laboratory Course in Airplane Structures. N. J. Hoff. Some ideas regarding an airplane-structures laboratory course are set forth by an Associate Professor of Aeronautical Engineering at Polytechnic Institute of Brooklyn. Specific objectives of such a course are enumerated. The principal topics of the article are an illustration of airplane structural theory, a comparison of theory and experiment, the development of an experimental technique, and other considerations. *The Journal of Engineering Education*, December, 1945, pages 262–268, 5 illus.

Electrical Equipment

A Carbon-Pile Speed Governor. C. T. Button. The writer describes a carbon-pile speed governor designed to hold substantially constant the speed and, consequently, the output fre-

American Airlines System Douglas DC-4, in transatlantic flight.

Skyway Express to London

What interests the passenger is the ease, comfort and speed of transatlantic air travel, as handled by American Airlines' big Douglas DC-4's. But to the engineer who knows the importance of maintaining schedules and operating efficiency, it's the equipment that counts. An example is the Auto-Lite ignition cable that serves such a vital function in the aircraft's electrical lifeline. Auto-Lite ignition cable, tested and proved in the fighting planes of the United Nations, is available now to make peacetime travel safer and more dependable than ever before.

SARNIA, ONTARIO **THE ELECTRIC AUTO-LITE COMPANY** PORT HURON, MICHIGAN
Wire and Cable Division

TUNE IN THE AUTO-LITE RADIO SHOW STARRING DICK HAYMES
EVERY SATURDAY NIGHT, 8:00 P.M.—E.S.T. ON CBS

AUTO-LITE *Aircraft* **WIRE & CABLE**

quency of aircraft inverters. The discussion is confined to the operation of controlling the speed of a d.c. motor that drives an a.c. generator. The operation of the speed regulator for d.c. motors is compared with that of the carbon-pile voltage regulator for a.c. motors. The rotating and stationary assemblies of the carbon-pile speed governor are described. *Electrical Engineering*, January, 1946, pages 4–7 (Transactions), 6 illus.

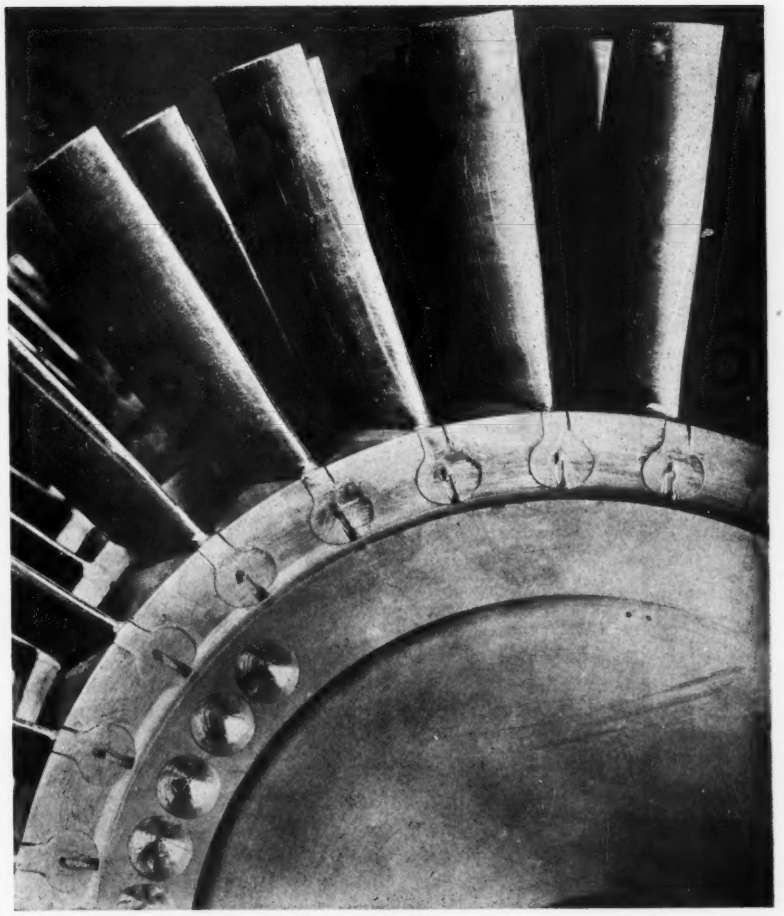
Don't Mishandle Aircraft Relays. O. M. Raith. The article supplies information about the design, construction, and handling of aircraft relays, which are used to control, in one electrical circuit, a function or operation required in another circuit. Requirements for aircraft relays and various design schemes, used to meet these requirements are described. Factors influencing the selection of relays are reviewed. Other sections pertain to the manufacture, installation, and final testing of aircraft relays. *Industrial Aviation*, January, 1946, pages 38–40, 55, 5 illus.

Engines

British Aircraft Gas Turbines. The Ninth Wright Brothers Lecture. H. Roxbee Cox. This paper is an introduction to the work done in Great Britain on aircraft gas turbines. It is intended to give a general impression, leaving the wealth of detail to be supplied by others. It deals with the early work of Whittle, Griffith, and Constant, done before the war in circumstances of considerable difficulty. The two main lines of development associated with axial and centrifugal compressors are traced, and the extension of this work into practically the whole of the British aircraft-engine industry is described. The contributions of the various British firms are noted, and the collaboration that was developed between them is the subject of special comment. There follow notes on the parallel collaboration that was developed between Great Britain and the United States and between Great Britain and the British Dominions.

Problems encountered in development and in the research are dealt with, and the facilities that are at the service of the British gas-turbine engineers are described. The paper contains discussion of the variety of problems which the advent of the aircraft gas turbine has initiated. For example, the characteristics of single- and double-sided centrifugal compressors are compared; the merits of axial and centrifugal compressors, of jet reaction, ducted fan, and propeller propulsive systems are considered; and an attempt is made to deal with the influences of the gas turbine on air-frame design. *Journal of the Aeronautical Sciences*, February, 1946, pages 53–87, 60 illus.

Armstrong Siddeley Cougar. Design and construction particulars are given for the Armstrong Siddeley Cougar engine. This nine-cylinder single-row radial engine, intended for use in medium-size transport aircraft and the larger type of single-engined trainers, is reported to have a relatively small diameter (49.5 in.), featured by close baffling. The engine is geared and supercharged and drives a Rotol constant-speed, full-feathering three-bladed propeller. For a take-off power of 850 b.hp., it has a net weight of 1,020 lbs. Among its features are an R.A.E.-Hobson fuel injector a metering unit in place of the carburetor, and departures in cylinder design from usual Armstrong Siddeley practices. *Flight*, January 3, 1946. page 11, 2 illus.; "The Armstrong Siddeley Cougar," *The Aeroplane*, January 4, 1946, pages 10, 11, 2 illus.



The bulb-type roots of the Westinghouse 19B turbojet compressor blades are held in place in milled disc slots by wire locking keys turned up into the grooved sides of the blade roots.

Design Analysis of General Electric Type I-40 Jet Engine. Dale D. Streid. An engineering study of the turbojet unit that powers the Lockheed P-80 and other planes is illustrated by sectional drawings of the unit and its components. Following a brief review of the development of the engine, the operating principles of the I-40 are outlined. Structural details are then described and performance information is given. Various charts and tables of pertinent data are included. *Aviation*, January, 1946, pages 51–59, 20 illus.

Design Analysis of Westinghouse 19-B Yankee Turbojet. John Foster, Jr. Principles of the design, construction, and operation of what is termed "the first American axial flow gas turbine power plant" are examined at length. Details reported include those relative to the oil cooler; bearings and bearing supports; guide vanes; compressor and compressor casing; straightening vane assemblies; fuel manifold; and combustion chamber. Other information reveals features of the turbine nozzle assembly; turbine disc, shaft, and coupling flange; exhaust nozzle; accessories; gear box; governor; and lubrication system. General specifications of the power plant are tabulated. Drawings and photographs illustrate the details. *Aviation*, January, 1946, pages 60–68, 16 illus.

New Gipsy Engines. As the first of the new Gipsy Queen Series 70 of de Havilland aircraft engines, features of the Queen 71 are surveyed comprehensively. In brief detail, the design and performance characteristics are investigated relative to units in the Gipsy Major Series 30 and 50 and the Queen Series 30, 50, and 70; the Gipsy Major 10; and the Gipsy Six II.

Triple reasons for specifying...

TRIPLE ALLOY STEELS *containing* NICKEL

1 PERFORMANCE—Strength and toughness, resistance to wear, fatigue or shock to meet a wide range of requirements, as dictated by design.

2 RELIABILITY—based on consistently uniform response to heat treatment.

3 ECONOMY—resulting from standard compositions precisely graded to match the engineers' needs.

Experience shows that triple-alloy steels containing Nickel are solving some mighty big problems in many industrial fields. They have established outstanding service records in some of the most exacting applications. The many standard compositions available make it possible to select *accurately*, and with economy, triple-alloy steels to fulfill the requirements of a great variety of applications.

We invite inquiries regarding the selection and uses of triple-alloy steels, containing Nickel.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N.Y.

The increased power output of the new engines is emphasized, along with the fact that they are supercharged and geared. In the illustrated review of the Gipsy Queen 71, features that are deemed particularly noteworthy are the spring-transmission coupling incorporated in the reduction gear, the dynamic vibration-absorbers on the crankshaft, and the coaxial arrangement of supercharger drive shaft and camshaft. Particulars stressed include those pertinent to the crankcase, constant-speed unit drive, and flexible coupling. Performance data for the Gipsy engine group are tabulated. *Flight*, December 27, 1945, pages 680–682, 9 illus.; "A New Series of de Havilland Gipsy Motors," *The Aeroplane*, December 28, 1945, pages 747–750, 5 illus.

Details of Chrysler 2500 Hp. Engine. Major constructional details of the 16-cylinder, 2,500-hp. Chrysler Model XI-2220 military aircraft engine are described. It is observed that the production and experimental development of this unusual V-16 engine were undertaken by the Chrysler Corporation at the request of the Army Air Forces before the United States entered the war, but it remained a military secret until almost 3 months after V-J Day. A design requirement was small frontal area combined with maximum power. The engine has a bore of 5.8 in. and a stroke of 5.25 in., which provides a piston displacement of 2219.2 cu.in. A compression ratio of 6.3 to 1 is used. The rated horsepower is developed at 3,400 r.p.m. Some general features of the development are enumerated, followed by details about the crankshaft, cylinder assembly, connecting rods, valve gear, supercharger, and the induction, cooling, and lubricating systems. *Automotive and Aviation Industries*, January 15, 1946, pages 24, 25, 96, 98, 100, 102, 3 illus.; "New, 2,500-HP. 'V' Engine Features Lightness, Accessibility," *Aviation*, January, 1946, pages 89, 90, 5 illus.

Combustion Research. Now that war restrictions have been lifted, the contributions of the English firm of Joseph Lucas, Ltd., to the research work concerning combustion in gas turbines can be revealed. The first problem was to simulate the conditions of air-mass flow and density found in the operation of the early Whittle engines, and the initial investigations were to determine the characteristics and examine the behavior of the Whittle W.2 and W.2B types. Following that work, a modified principle of air injection was developed and the basic design, known as the B.23 chamber, has been applied to all subsequent models. The test building and equipment that were provided for the work and additional equipment planned for testing the components of more recent units are described. The four main lines of investigation are chemical and physical, aerodynamic, thermodynamic, and mechanical. The work performed under each of these classifications is reviewed and the apparatus is described. How the results of the research were embodied in the mechanical design and fabrication methods for various makes of gas turbines is related, and specifications are tabulated. *Flight*, January 3, 1946, pages 12, 13, 15, 9 illus.

Flight Technique

Props and Power. Ken Lester. The relationship of manifold pressure, engine speed, and engine power, in connection with the use of a controllable-pitch propeller, is explained. The writer gives instructions for setting the engine speed and the propeller pitch in such a way as to get the greatest efficiency and take advantage of the indications given by the manifold-pressure gage and the engine tachometer. *Air Facts*, February, 1946, pages 43–49, 2 illus.

Flight Testing

The Determination of the Stalling Speed and the Maximum Lift Coefficient in Flight. Ernest W. Graham and Harold Luskin. An analysis has been made of the errors that may be encountered in conducting stalling-speed flight tests. The errors were found to result from four causes—pilot technique, test conditions, airplane configuration, and instrumentation. A tabular breakdown of these items is presented, with an estimate of their approximate order of magnitude and an appraisal of the possibilities of eliminating or correcting the errors. The largest errors resulted from inadvertent normal accelerations (particularly in the case of unusual approaches to the stall, as in level flight), power, and trailing-bomb lag. The more important small errors include those due to flight-path inclination, angular velocity in pitch, and induced velocity at the bomb. Procedures and corrections were considered in an effort to find means for eliminating the errors or their effects.

As a concluding portion of the study, a procedure is recommended for the flight determination of the power-off maximum lift coefficient and stalling speed. This procedure specifies the following:

(1) A deceleration of no greater than 0.5 m.p.h. per sec.

(2) Zero thrust set at not to exceed 10 per cent above the stalling speed.

(3) Use of a trailing bomb, with a correction for induced velocity.

(4) A correction for flight-path inclination. (To be applied to maximum lift coefficient but not to stalling speed.)

(5) Use of sensitive accelerometers.

(6) Measurement of the stalling speed as that at which uncontrollable pitching takes place or the minimum obtainable in steady controlled flight. *Journal of the Aeronautical Sciences*, February, 1946, pages 95–107, 13 illus.

Aircraft Performance Testing and Reduction by the "iw" Method. J. J. Green and F. S. Nowlan. The writers describe and analyze the so-called "iw" method for the determination of aircraft performance in a standard atmosphere from flight tests carried out from day to day under nonstandard conditions. The opening section of the paper is devoted to an exposition of the theory on which the method is based. Flight testing, the derivation of performance at altitude in the standard atmosphere, the determination of critical altitude, coarse pitch setting, and the effect of air-frame changes are then considered. Numerous charts and tables of test data are included. *The Engineering Journal*, December, 1945, pages 758–771, 783, 14 illus.

Hovering over Paricutin. George Wales. An account of how the Air Technical Service Command dispatched an experimental mission to a volcano site 200 miles west of Mexico City to test a helicopter under flight conditions similar to those in the China-Burma-India theater. A Sikorsky R6-A helicopter was used. It is stated that valuable data were secured from the flights. *American Helicopter*, January, 1946, pages 10–12, 6 illus.

Fuels

A Short Discussion on Jet Fuels. Ben Goulston. A study is made of the factors governing the selection of a type of fuel best suited to the jet engine. Stating that petroleum hydrocarbons offer the best available source of energy, the writer notes that, at present, the type of fuel demanded is a paraffinic kerosene possessing a low freezing point. *Commercial Aviation*, December, 1945, pages 40, 44.

Gliding and Soaring

Glider Boys Disapprove. Criticisms are made of the new regulations for airworthiness procedure and other requirements for gliders and their use in New Zealand issued by the Civil Aviation Branch of the Air Department in leaflets P6, P7, and P8, referring, respectively, to the importation of gliders into New Zealand, manufacture of gliders there, and glider equipment. The complaints include objections to the difficulties of getting approval of imported gliders that conform fully with the requirements of the country of origin and the lack of suitable provisions for approval of gliders built by individuals or clubs from local materials or from kit sets. In general, the regulations are stated to be incomplete and old-fashioned and unsuitable for gliders, apparently having been adapted from practices referring to powered aircraft. Numerous other objections are listed with respect to the limitations on imported craft and materials for building them and the lack of provision for the encouragement of gliding by schools and clubs. *Whites Aviation*, November, 1945, pages 6, 7, 3 illus.

History

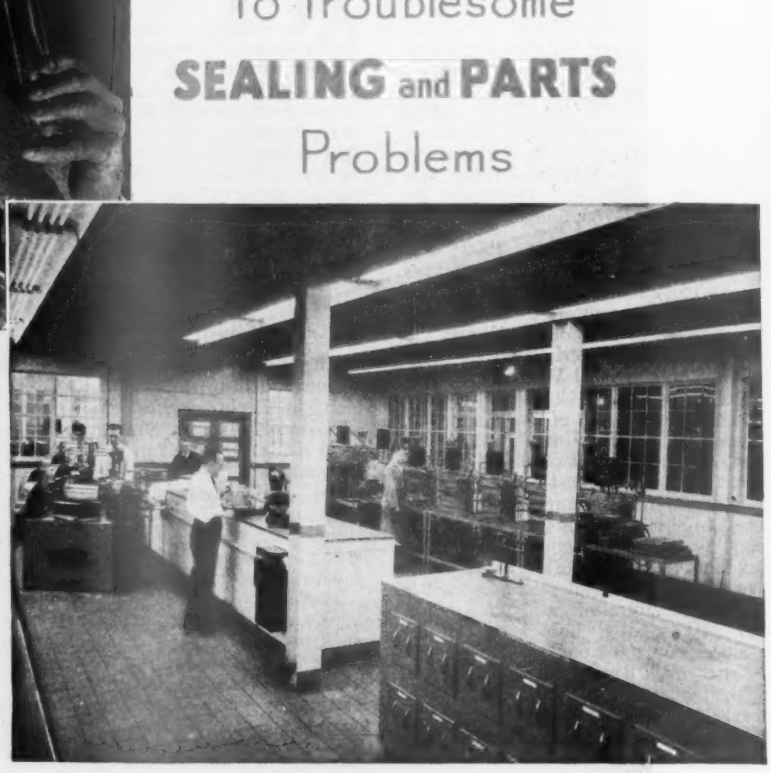
In the Days of the Crates. Vance J. Hoyt. Some of the early aircraft

Here's Your Answer

to Troublesome

SEALING and PARTS

Problems



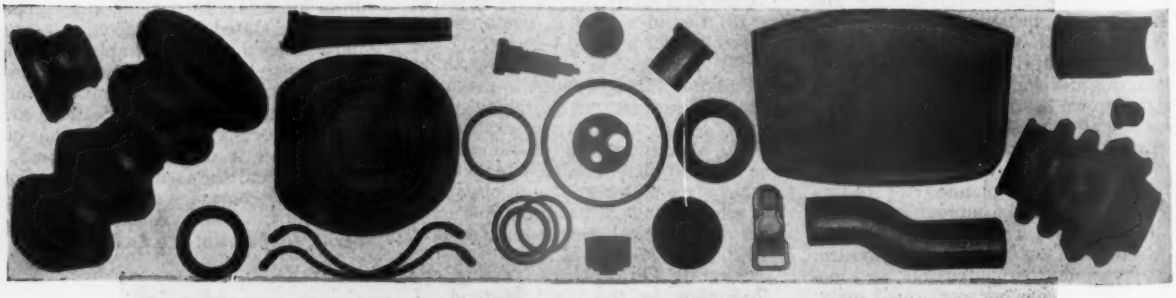
This test tube has contained the answer to many perplexing sealing problems, many machine part and product "bugs." It will have the answer to your difficulties if you put our skilled Engineering and Laboratory Staffs on the job.

Years of constant research, extensive modern laboratory and production facilities place us in top position to design and precision-mold to exact specifications any part or product of natural or synthetic rubber in any quantity by compression, injection or transfer methods.

Our daily job orders resemble a "who's who" listing of industrial leaders, yet a large percentage of our production is shipped to specialty manufacturers and small industrial plants.

We welcome all requests to study problems and recommend solutions. As we mold all types of rubber by many methods, our recommendations are not influenced or biased by limitations of materials, methods or equipment. When writing include full details, specifications or samples.

Acushnet PROCESS CO.
New Bedford, Mass., U.S.A.
Precision-Molded **RUBBER** *Parts & Products*



If it can be molded of Rubber **ACUSHNET** *will mold it!*

that have made aviation history are briefly described. Data on the performance of these aircraft and the achievements of the men who designed and flew them are included. *Air Trails*, February, 1946, pages 34, 35, 86, 88, 8 illus.

Inspection

An Investigation of the Fluoroscopy of Light Alloy Castings. B. Cassen and D. S. Clark. An investigation of the advantages of fluoroscopy as applied to the detection of flaws in light-alloy castings was conducted at the California Institute of Technology for the Office of War Production Research and Development of the War Production Board. Its purpose was to determine more precisely the limitations of fluoroscopy; the possibilities of improving fluoroscopy; the possibilities of substituting fluoroscopic examination for radiographic methods of certain types of inspection; and the possibilities of extending the scope of fluoroscopic inspection methods to parts that cannot be radiographed economically. The preliminary experiments are reviewed, and the equipment used for carrying them out is described. To obtain a quantitative statement of fluoroscopic performance, a series of artificially simulated defects of known size were examined under controlled laboratory conditions. The investigations indicated that some of the popular notions of fluoroscopic performance and limitations are not entirely correct. *Automotive and Aviation Industries*, January 1, 1946, pages 26–30, 78, 82, 85, 9 illus.

Instrument Flying

Instrument Rating for Military Pilots. Frank J. McMackin. Ex-service pilots are told about the instruction routines, tests, costs, etc., connected with obtaining civilian instrument ratings. The advice is based upon the writer's related experiences and problems in getting his own rating after his release from the Navy. Part of the article is devoted to an account of how a third-class Radiotelephone Operator's Permit may be obtained. *Air Facts*, February, 1946, pages 52–58.

Lighter-Than-Air

The Airship's Side of the Story. James N. Blissell. The writer describes how the airship may be applied to air transportation in the postwar era. He explains what it offers in place of speed and how it will rank as a cargo and passenger carrier. *Air Transportation*, December, 1945, pages 44–46, 1 illus.

Ballast Taken on Aloft. A Navy-designed water pickup device, intended to enable airships to take on water ballast from the ocean while in flight, is described. The object of the device is to eliminate the need for valving away the precious helium gas as fuel is used up and the airship becomes lighter. *Popular Science*, February, 1946, page 75, 1 illus.

Lubrication

Limitations of Greases for Anti-Friction Bearings. Hudson T. Morton. Tests commonly used to determine the characteristics and probable operating behavior of greases as applied to antifriction bearings are discussed. Some further tests, now under consideration by the National Lubricating Grease Institute and the American Society of Testing Materials, are listed. *Lubrication Engineering*, December, 1945, pages 108, 109.

Maintenance

Top Overhaul. Part II. Harvey A. Senior. Part II of a continued article about the overhauling of aircraft engines supplies information about assembling and running in the engine. Illustrations show various assembly operations. *Aviation Service Magazine*, January, 1946, pages 8–11, 7 illus.

Special Equipment and Precision Tools Help in Speeding Propeller Service. Ed Packer. The writer describes how special equipment built in the shops of Northwest Airlines, used in conjunction with commercially produced precision tools, is speeding propeller service. Illustrations show service operations and equipment. *Aviation Service Magazine*, January, 1946, pages 12–18, 17 illus.

A Right Bower for the Mechanic. B. J. Cumnock. The certified repair manual developed by Braniff Airways to aid foremen mechanics in the servicing of DC-3 aircraft is reviewed. The repair procedure provides that similar repairs be made to identical specifications. Illustrations show a minor repair form that gives a constant means of recording repairs and weight-change information and a form for recording extensive fuselage repairs. A specification page from the manual detailing a floor-beam reinforcement is included. *Air Transport*, January, 1946, pages 42–44, 3 illus.

Pointers on Aircraft Riveting. Louie Boer. Types of rivets used in aircraft repair work are reviewed, and proper methods of applying the rivets are described. *Aviation Service Magazine*, January, 1946, pages 20–25, 13 illus.

Care of Gyro Instruments. Suggestions about the care of gyro instruments are offered. The construction of these instruments is briefly explained, and information is supplied about lubricating them, cleaning the air filters, etc. *Aviation Service Magazine*, January, 1946, pages 26–29, 41, 15 illus.

Spark Plug Service. Suggestions for the servicing of spark plugs for aircraft engines are made. The writer explains how to remove, clean, and adjust the plugs. *Aviation Service Magazine*, January, 1946, pages 36–38, 46, 10 illus.

Management

Industrial Safety Turns a Page at PAA. Gilbert F. Tyler. A description of how an accident-prevention manual was developed by Pan American Airways to meet a new set of safety problems created when C-54 aircraft replaced flying boats. It is explained that, in compiling the manual, reasons rather than rules were emphasized. Extracts from the manual reveal the

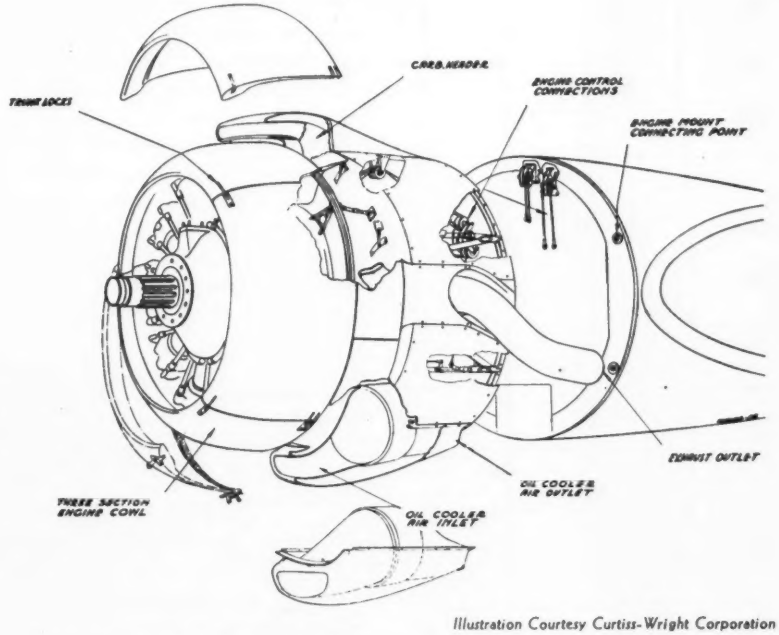


Illustration Courtesy Curtiss-Wright Corporation

A new power unit—a Cyclone 9HD engine with a prefabricated nacelle—is designed to be attached directly to the present Douglas DC-4 wing and fire wall without modifying the frame of the airplane in any way. The first delivery of the packaged power units is scheduled to be used by Chicago and Southern Airlines on DC-4 Skymasters.

NO FINER BLADE WAS EVER MADE

Standard Equipment...

...STANDARD OF PERFORMANCE

ONE after another, the new personal planes are coming off the drawing boards, off the production lines, into the air. Never in the history of aviation were there so many, never was competition keener. That is one reason why the order of *improved performance* is the order of the day. The new ships—such as the new Ercoupe, shown above—are finer, smoother, faster. But there is one thing that remains unchanged—the designers' preference for Sensenich Propellers as Standard Equipment. No other propeller is chosen so often by so many.

Sensenich—world's largest manufacturer of wood aircraft propellers, *knows how* to design and build for maximum efficiency of any aircraft. Be sure that your ship is Sensenich equipped and you can be sure of getting maximum performance. Write for free booklet listing Sensenich Propellers for all aircraft under 250 h.p.

AIRCRAFT SENSENICH PROPELLERS

REPAIR SERVICE. If your propeller needs repairing, send it to the Sensenich PROP SHOP. Any make. Prompt and efficient service. Denver and West please use Glendale station.

SENSENICH BROTHERS • Main Plant, LANCASTER, PA. • West Coast Branch, GLENDALE, CALIF.

approach to accident control under the conditions imposed. *Air Transport*, January, 1946, pages 34–39, 12 illus.

Marketing

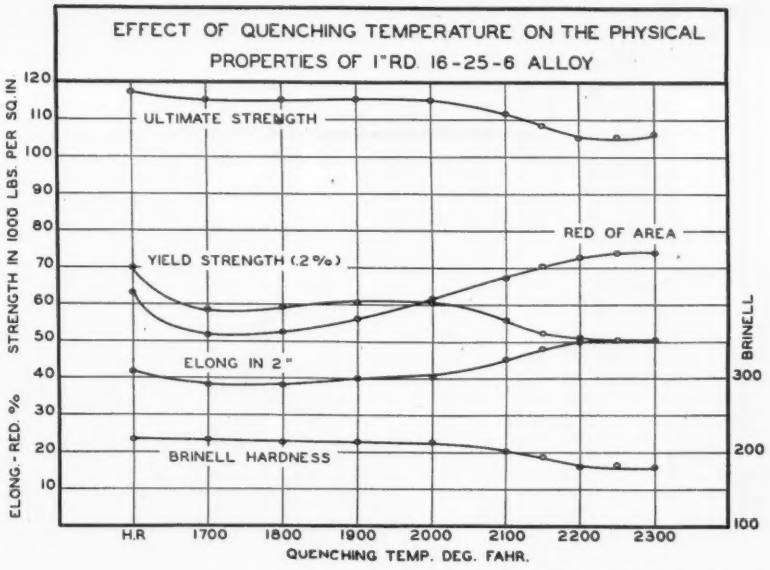
Piper's Sales Training Course. The sales-training course developed for the Piper Aircraft Corporation by the Aviation Institute of Professional Sales Training is described. It is intended to assist salesmen, dealers, and service-operator personnel in developing their abilities for the selling of aircraft, aeronautical products, and services. The course consists of a series of 24 field-tested weekly lessons, divided into three major groups: (1) preplanning the sales interview; (2) dramatizing the sales interview; and (3) developing sales personality for aviation selling. Each of the 24 texts contains a problem in selling based on the sales principles explained in the text, and the student is required to solve the problem and apply the lessons to future studies. The lessons are supplemented by questionnaires framed in such a way as to accentuate the sales principles involved and to fasten the instruction firmly in the mind of the student. *Aero Digest*, January, 1946, pages 88, 121, 1 illus.

Materials

A New Mass Balance Alloy. Characteristics, properties, and applications of a new heavy alloy are discussed. Developed by the General Electric Company Ltd., the material is a product of powder metallurgy, containing about 90 per cent tungsten alloyed with nickel and copper. It is manufactured by sintering mixed metal powders at a temperature of approximately 1,450°C. and is said to be readily machinable. Two of the principal uses cited for aircraft design are for balancing control surfaces and for balancing crankshafts in aircraft engines. The most important properties of this heavy alloy are tabulated. *The Aeroplane*, January 4, 1946, page 11, 1 illus.

16-25-6 Alloy for Gas Turbines. Martin Fleischmann. A two-part article in which the writer, who is a metallurgical engineer of the Timken Roller Bearing Company, describes a new alloy he developed for gas-turbine and supercharger applications. In Part I he explains how results obtained with 16-13-3 steel pointed the way to the development of the new alloy, which is designated as 16-25-6 and has a high creep resistance at elevated temperatures, important for jet-engine applications. Photographs show the microstructure of samples of the new alloy when hot-rolled and when solution-quenched at different temperatures and for different periods of time. Charts show the effect of tempering on the physical properties of the alloy.

In Part II the writer describes the effects of cold-work on the physical properties of the new alloy and on its microstructure, its high-temperature properties, and its possible applications. He also compares the new alloy with other austenitic and pearlitic steels. *The Iron Age*, January 17, 1946, pages 44–53, 21 illus.; January 24, 1946, pages 50–60, 24 illus.



Photograph Courtesy Timken Roller Bearing Company

Medicine

History of Progressive Changes in Equipment Used by the Medical Department. Col. Gustave E. Ledfors. Progressive changes that have occurred in the equipment used by the medical department personnel of the Army Air Forces are reviewed. The writer describes how new ideas were applied and more elaborate medical assemblies were developed. *The Journal of Aviation Medicine*, October, 1945, pages 356, 357, 359.

Effectiveness of Pre-Flight Oxygen Breathing in Preventing Decompression Sickness. F. M. Henry and S. F. Cook. Reference is made to earlier investigations that have shown that the breathing of pure oxygen prior to actual or simulated ascent to a high altitude diminishes the occurrence of joint pain and other symptoms of decompression sickness and to the widely accepted theory that the effect is induced by the progressive removal of nitrogen from the blood and tissues, thus reducing the incidence of bubble formation when the external pressure is lowered. A study initiated in the laboratory of the University of California in order to secure an adequate quantitative evaluation of preoxygenation as a means of preventing aeroembolism is reviewed. Three experiments were carried out, all of which involve the "ascent" by the subjects to simulated altitudes of 35,000 ft. or more in a decompression chamber. The conclusions reached are summarized. *The Journal of Aviation Medicine*, October, 1945, pages 350–355.

Report of Death of Passenger Under Treatment by Pneumothorax. K. E. Dowd. The case of a patient under treatment for pneumothorax whose death was considered to be caused by air travel is presented. Sections of the article are devoted to the history of the case, the examination, treatment, laboratory findings, and autopsy. *The Journal of Aviation Medicine*, October, 1945, pages 346–349.

The Diagnosis of Migraine in Flying Personnel. Lt. Col. David B. Davis and Capt. John W. Bick, Jr. It is noted that, in the military service generally and in flying personnel in particular, headaches are a familiar complaint. It is stated that emotional stress is a frequent cause of the symptom in flying personnel. The opinion is expressed that, actually, migraine in the military service is extremely rare. Of 100 patients admitted to a hospital with a diagnosis of migraine, thorough study confirmed the diagnosis in only two cases. Characteristics that indicate a case of migraine are listed. Two cases are described that illustrate the various errors that arise when the diagnosis of migraine is applied without sufficient justification. *The Military Surgeon*, January, 1946, pages 17–20.

Effect of Diet on Altitude Tolerance. Morris Eckman, Beatrice Barach, Charles A. Fox, Charles C. Rumsey, Jr., and Alvan L. Barach. Reference is made to past investigations that indicate that the net gain in altitude ceiling for aviators receiving moderately high-carbohydrate meals is slightly over 1

Save a place

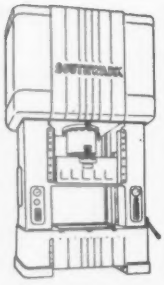
at your planning table

for a BALDWIN PRESS ENGINEER

If you've watched the trend in plant and shop equipment, you know that every year more and more presses have been finding their way into production lines.

Results that once used to require a dozen different shaping, machining and joining operations are now produced by a single thrust of a piston. In addition to economy, the product often gains in strength, appearance and utility because it is formed rather than assembled.

When you're thinking of tomorrow's



products...and tomorrow's competition...the profit and production possibilities of presses are too important to overlook. One of our engineers will be glad to review your manufacturing problem, and suggest the places where a Baldwin Press can help you produce better, faster and more economically in metal, plastics or rubber.

The Baldwin Locomotive Works, Baldwin Southwark Division, Philadelphia 42, Pa. Offices: Philadelphia, New York, Chicago, St. Louis, Boston, Washington, San Francisco, Cleveland, Detroit, Pittsburgh, Houston, Birmingham.

BLW THE BALDWIN GROUP

BALDWIN

SOUTHWARK

HYDRAULIC PRESSES

mile. Because a gain in altitude tolerance of 5,000 ft. would be of great importance, experiments were performed, at the Aviation Research Laboratory of Columbia University, to determine the effect of a high-carbohydrate diet on the blood gases and arterial oxygen and carbon-dioxide pressure, the alveolar and expired gases, and psychomotor efficiency. The results of studies on the effect of diet on altitude tolerance at levels of 15,000 and 17,000 ft. are summarized. *The Journal of Aviation Medicine*, October, 1945, pages 328–340, 349, 3 illus.

The Relationship of Anoxia Susceptibility to Diet. Lt. Col. D. M. Green, Major J. S. Butts, and Major H. F. Mulholland, with the technical assistance of Capt. R. M. Moore, Capt. R. W. Ollayos, Lt. H. B. Griffin, Lt. A. B. Shaklee, Lt. L. J. Mullins, and Lt. A. B. Roelofs. Theoretic considerations are presented which indicate that the feeding of diets high in carbohydrate and low in protein should reduce susceptibility to anoxia by diminishing metabolic requirements and facilitating gaseous exchange in the lungs. Results of a study made by C. G. King and his associates, using a small number of subjects, are said to support the hypothesis. Details about a repetition of the study conducted on a larger scale on air-crew personnel are included. From the results obtained it is concluded that susceptibility to anoxia may be reduced by the feeding of diets high in carbohydrate prior to ascent. The study was carried out under the auspices of the Medical Section, 73rd Bombardment Wing, at Smoky Hill Army Air Field, Salina, Kan. *The Journal of Aviation Medicine*, October, 1945, pages 311–327, 11 illus.

A Study of Aero Medical Problems in a Liberator Bomber at High Altitude. John H. Lawrence, Cornelius R. Tobias, William R. Lyons, H. Fred Helmholz, Jr., and A. Randolph Sweeney, Jr., with the flight assistance of Ezra V. Bridge and Owen L. Williams. A detailed comparative study of bends in a series of 25 airplane flights at 35,000 ft. and in extensive low-pressure chamber simulated flights is reported. Decompression sickness observed under both conditions was found to be similar in degree, nature, and incidence. Certain other aeromedical problems encountered in flight are discussed and solutions are advanced or suggested. A study of 167 man-flights at 35,000 ft. showed that, although it is possible for men to fly and work at such an altitude in nonpressure cabin planes, preselection and preoxygenation are necessary and that, even then, occasional severe reactions are to be expected. The work described was done under a contract between the Office of Scientific Research and Development and the University of California. *The Journal of Aviation Medicine*, October, 1945, pages 287–310, 6 illus.

An Improvement in Technique of the Proetz Method of Treating Paranasal Sinusitis. Capt. Maurice J. Hoilien. The gain in popularity, especially among flight surgeons, of the Proetz method of treating sinusitis by installation of a shrinking agent in the paranasal sinuses is referred to. A simple method is outlined for overcoming certain difficulties encountered with this treatment and increasing its effectiveness. *The Journal of Aviation Medicine*, October, 1945, pages 358, 359.

Merchandising

Wanted: Aircraft and Accessory Retailers. Arthur S. Brown. Charging that in the past aircraft distributors often competed with dealers in selling direct to the consumer, the writer predicts that distributors seeking future franchises will need to have bona fide sales organizations and give wholehearted support to their retailers. It is also his opinion that changes will be necessary to make dealerships more attractive and profitable, with the distributor (or wholesaler) working on smaller effective margins than the dealer (or retailer). *Aviation*, January, 1946, pages 107, 176, 179, 180.

Meteorology

Certain Aspects of Aircraft Icing in the Alaskan-Aleutian Area. Capt. O. N. Serbein, Jr. Past studies of aircraft icing which have emphasized the importance of temperature and turbulence in determining the type and intensity of ice formation are reviewed. Recent investigations in the Alaskan-Aleutian area involving some 1,413 icing cases and 14,843 pilot reports, which provide additional information regarding these two elements, are discussed. The summaries are based on weather observations taken by troop-carrier pilots during flights over southern Alaska. *The Bulletin of the American Meteorological Society*, December, 1945, pages 419–425, 2 illus.

Transformation of Polar Continental Air to Polar Maritime Air. Lt. Cletus J. Burke. The changes in the content of heat and water vapor which characterize the transformation of continental-polar air as it moves out over the sea are considered. Computations indicate that these changes can be accounted for by the transfer processes operating at the sea surface. A solution is obtained for the surface air temperature at any phase of the transformation in terms of the initial surface air temperature, the initial lapse rate, the sea-surface temperature, and the distance the air has traveled over the sea. The solution is given graphically for the use of the forecaster. Temperatures are computed for 96 cases and are compared with the observed temperatures. The writer is an officer in the Army Air Forces, and the subject is applicable to work in aeronautical meteorology. *The Journal of Meteorology*, June, 1945, pages 94–112, 13 illus.

Notes on the Akron Thunderstorm of July 7, 1943. Paul O. Huss and Raymond C. Robinson. A brief analysis is made of an interesting wind pattern that was registered at the Daniel Guggenheim Airship Institute tower on July 7, 1943, during a severe thunderstorm. Wind velocity and direction charts are reproduced and discussed. A brief résumé of the pressure and frontal system during the 24-hour period is included. Comments are made about the air-mass characteristics. *Bulletin of the American Meteorological Society*, December, 1945, pages 414–418, 6 illus.

Model Airplanes

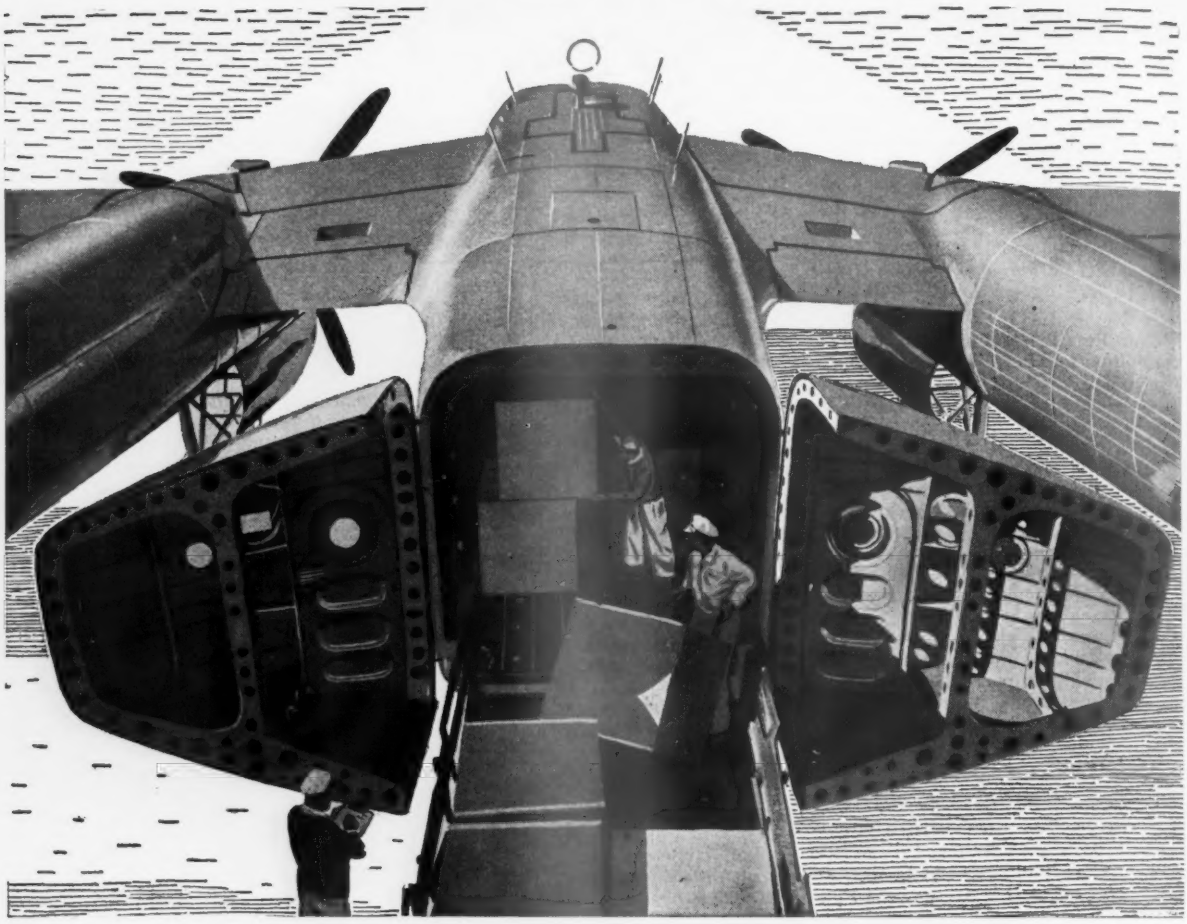
The Gen on "Diesel" Engines. Lawrence H. Sparey. The present state of development of the miniature "Diesel" engine in the field of model-engine building is outlined. It is observed that in the model field the term "Diesel" is applied to compression-ignition engines without fuel injection. Various designs of single-cylinder, two-cycle "Diesels," having piston displacements ranging from 0.7 to 5 cu.cm., are described and illustrated. Particulars about a component called the "contra-piston" used to adjust the compression ratio are included. It is stated that the compression ratio usually used is around 16 to 1. *Aeromodeller*, December, 1945, pages 41–44, 9 illus.

Naval Aviation

Deck-Landing the Sea Vampire. From the trails of the first jet and first tricycle aircraft for the Royal Navy, a report is made of the deck-landing qualities of the Sea Vampire. The tests under consideration were a series of 15 take-offs and landings conducted from and on a 14,000-ton light fleet carrier. Landing advantages of the tricycle-and-jet arrangement are explained. *Flight*, December 13, 1945, pages 631–633, 9 illus.

Paints and Coatings

Nitriding of Aircraft Steels. P. A. Haythorne. A report of an investigation that was conducted for the purpose of clarifying conflicting data relating to the actual properties obtainable when the nitriding process is applied to several types of structural aircraft steels that are not specifically known as nitriding grades. Depth hardness data on these steels, nitrided under varying conditions of temperature, time, and ammonia dissociation, are discussed. Data indicate the case hardness and



YOU'LL SHIP IT B.F.B.*

with Packet-Proved Economy

More of your freight will be sped ***By Flying Boxcar** in the age of "flying freight" which is now at hand for an air-minded nation.

For Fairchild ingenuity in design and engineering has wrapped up in the cargo-carrying "Packet" the essentials for successful air freight operations—speed, economy, low-cost maintenance and operation.

The "Packet" is the first airplane designed *specifically* to carry cargo. Its low direct operating costs of less than 7 cents a ton-mile for a 500-mile trip challenge rates for other forms of cargo transportation!

The 1946 model of this Army Air Force-proved freighter incorporates all the latest improvements in design and construction. Electrically operated landing gear, exhaust heating of wings, tail and fuselage, excellent stall characteristics are but a few of its advanced features.

Carrying up to 9 tons of freight in its unobstructed, box-like interior, the "Packet" can be loaded and unloaded with ease through split-tail doors at the rear. These open up to the full width of the fuselage. A forward cargo door permits quick access to "up-front" freight, and the horizontal floor, studded with recessed tie-down rings, is at convenient truck floor height.

In the "Packet", cargo operators and prospective cargo operators have a plane ready-made for their purposes. Like all Fairchild products, it offers "the touch of tomorrow in the plane of today."

Write for complete details on the "Packet" today.

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland

penetration characteristics that may be expected from optimum processing conditions. *The Iron Age*, January 31, 1946, pages 44–48, 8 illus.

Personalities

Salesmen at Work. The career of Robert E. Gross, President of Lockheed Aircraft Corporation, is reviewed. Brief comments are added about the contributions of Courtlandt S. Gross, Vice-President and General Manager of the company, as well as other leading executives, including Cyril Chappellet, Vice-President in Charge of Administration; Hall L. Hibbard, Vice-President and Chief Engineer; Carl B. Squier, Vice-President in Charge of Sales and Service; and Charles A. Barker, Jr., Vice-President and Treasurer. The article recounts activities of the Gross brothers before they became connected with Lockheed Aircraft Corporation and emphasizes their outstanding contributions, as well as those of the other executives, to the progress of the company and the industry. *Time*, January 14, 1946, pages 77, 78, 80, 82, 84, 86, 5 illus.

Montgomery and the Birds. John Hettich. The second of a series tells of the work of John J. Montgomery in building early aircraft based on studies of the flight of birds. His experiments with the laws of aerodynamics and his work in building gliders are reviewed briefly, as well as the experiences of Daniel Maloney in flying gliders built by Montgomery. *Aero Digest*, January, 1946, pages 40, 124, 1 illus.

Personnel

Aviation Jobs in Radio. Joan David. Job possibilities are noted for veterans with radio training and experience. The jobs described are mainly those with Aeronautical Radio, Inc., or the Civil Aeronautics Authority and include those connected with ground-station and traffic-control operation, airborne radio operation, and radio maintenance work. Salary ranges for the different types of work are reported. The article also gives a brief account of the functions and operating methods of Aeronautical Radio, Inc., commercial communications network. *Skyways*, February, 1946, pages 50, 51, 100, 101, 3 illus.

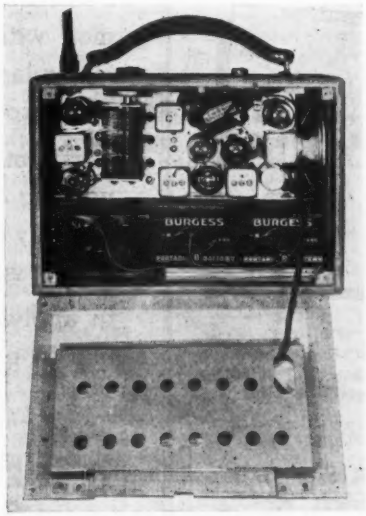
Selecting Reliable Airport Operators. Leigh C. Fisher. The writer stresses the economic importance to an airport operation of making sure that fixed-base operations, fuel stations, repair stations, food vending stations, and other related airport functions are manned by a courteous, efficient, and high type of personnel. A set of operating standards is suggested for selecting responsible lessees and concessionaires, while a system of employee training is also recommended. In addition, a course of action is outlined for developing increased airport patronage through relationships with lessees, concessionaires, and employees. *Southern Flight*, January, 1946, pages 56, 57, 60.

Private Flying

Lightplane Noise. The results of a study of what can be done to lessen the noise emitted by light airplanes in flight are reported. The study was undertaken in an effort to lessen the complaints of residents in the vicinity of airports. The experiences of the Royal Air Force and British aircraft manufacturers in developing relatively silent small airplanes are cited, as well as the facts stated in a National Advisory Committee for Aeronautics technical note. The causes, intensity, and nature of the noise made by an airplane in flight are included. The principal sources of noise are classified as the engine exhaust, the propeller, and the "clatter" of the engine parts. Figures are quoted relative to the measurement of airplane sounds and their intensities, compared with other sounds. It is shown that noise can be lessened by increasing the diameter of the propeller, using three or four blades instead of two, and reducing the tip speed by gearing. Comments are made about the efficacy of various types of mufflers and manifolds for reducing engine-exhaust noises, with respect to the power losses and other disadvantages of engine-silencing devices. *National Aeronautics*, December, 1945, pages 15–17, 24, 25, 3 illus.

$50-a-Week Flyer. To prove that the personal airplane can be maintained and operated by a man with a small income, the writer describes the experience of a $50-a-week factory worker with a wife and two children who has owned a plane since 1938 and has used it like a family car. Figures are quoted with regard to the cost of maintaining the plane. *Air Trails*, February, 1946, pages 30, 31, 107, 108, 6 illus.

'The Bite.' Fred Hamlin. Warning of the evil effects of such practices upon the expansion of aviation, the writer claims that many fixed-base operators are gouging private fliers. He cites case histories of excessive charges for repairs, insurance, storage, hangar space, maintenance facilities, plane rentals, and instruction. As a guide to what normal rates should be for instruction, hangar space, etc., summaries are offered of surveys on the subject by the Aircraft Owners & Pilots Association. Operators' justifications for so-called "overcharges" are considered, while A.O.P.A. efforts to combat the evil are also noted. *Flying*, February, 1946, pages 21–23, 118, 120–122, 4 illus.



An interior view of the new Learavian—the three-band portable radio manufactured by Lear, Incorporated, for private planes—shows the compact arrangement of the components.

What of Private Flying? James Hay Stevens. The outlook for private flying in Great Britain is examined in the light of postwar conditions in that country. The writer reminisces about the activities of the flying clubs in prewar years and comments about available British light airplanes, airport facilities, and other aspects of private flying in England. He gives particulars concerning several popular makes of British light airplanes, with tabulated specifications, and concludes with remarks about the "luxury" market for larger and more expensive types of passenger aircraft. *Air Training Corps Gazette*, January, 1946, pages 2–6, 16 illus.

Flying Club, Inc. The organization and operations of Flying Club, Inc., of St. Louis, are outlined as an example of the way to overcome the limitations of other methods of providing joint facilities for private flying. It is noted that flying clubs are generally classified into three types. One is the social or fraternal type in which members receive no proprietary interest; another is the partnership type in which members make an investment and receive a proprietary interest; and the third class is the corporation, which includes both the investment and proprietary-interest features. Difficulties have been encountered in the first two classes in such matters as the high cost of flying time and instruction in the first class; and poor management and inequitable division of the costs, responsibilities, and usefulness of the aircraft owned on a partnership basis in the second class. Most of the disadvantages have been eliminated by adopting the corporate form of organization, by which the members avoid individual financial responsibility for the club's obligations and, with adequate management, secure equitable allotments of the costs and flying time of club-owned aircraft. The five principles upon which the club is operated are listed. *National Aeronautics*, January, 1946, pages 17, 18, 2 illus.

Nobody Loves a Hot Pilot. Charles A. Parker. The ex-Service pilot is advised of what requirements he must fulfill and what conditions he will find in flying personal aircraft after his military experience. Channels for procuring civil licenses are indicated, with an outline of some of the C.A.A. regulations covering pilot certificates and ratings. Average costs for hiring and operating private planes are reported; the requirements for "checking out" when flying for the first time with a commercial operator are mentioned; and the different psycho-

A precision *Light Duty* **PUSH-PULL** for light planes

Now—simpler, lighter, less expensive push-pulls are available under the Simmonds name, with the same plus qualities of the famous Simmonds controls. The Light Duty type, being precision-built, offers many advantages. In the unique patented sliding member, or linkage, swaged phosphor bronze bearing rings girdle the flexible steel cable at ⅝" intervals, reducing friction and giving added strength. In compression, these rings hold the cable compactly and enable it to stand a thrust up to 20 pounds. For heavier loads, Simmonds Standard push-pulls are recommended.

A "natural" for light plane installations on engine throttle, parking brakes, etc., the Light Duty push-pull can detour through structural jungles, save installation time because it is pre-formed and pre-assembled, and absorb vibration in use. It is available with rigid or flexible casing and a variety of accessories.

The Simmonds Push-Pull Control Systems now cover virtually every load requirement from 1 to 60 pounds. Nearly a million sets have given outstanding service on military and commercial aircraft. Write today for additional information, or submit your problem for free engineering analysis.

DATA FOR DESIGNERS

Load—Up to 20 lbs. in compression; heavier in tension.
Weight with rigid tubing—0.1 lbs./ft.
Outer diameter—¼" for rigid tubing.
Stroke—Up to 5"; longer on request.
Exceeds AN test requirements.
To order: Submit plan and side elevation sketches of principal dimensions, showing necessary bends. Templates of bent ¼" rod may be used for quotations or for prototype installations.

Other Simmonds Products: Pacitor (Electronic) Fuel Gauges—Automatic Engine Controls—Spark Plugs—Hydraulic Accumulators—Aneroid Capsules—Fasteners and Clips

Simmonds AEROCESSORIES, INC. PRODUCTS, INC.

General Offices: 21-13 49th Avenue, Long Island City 1, N. Y.

Customer Service Offices: Dayton, Ohio—Glendale, California
Montreal, Canada—New York, N. Y.

DARNELL
Casters & Wheels

Darnell Double Ball-Bearing Casters and E-Z-Roll wheels reduce floor wear to a minimum, lengthen the life of equipment and increase the efficiency of employees—Write for 192 page Darnell Caster and Wheel Manual.

DARNELL CORP. LTD.,
LONG BEACH, CALIFORNIA,
60 WALKER ST., NEW YORK, N. Y.
36 N. CLINTON, CHICAGO, ILL.

ATTENTION
Aircraft Engineers

Permanent positions are available to men with above average ability in major layout, design, stress analysis and aerodynamics.

A minimum of 3 years' college engineering or its equivalent in supplementary training and 3 years' experience is required.

In applying send complete information on education and experience to

Engineering Department

BEECH AIRCRAFT CORPORATION

WICHITA 1, KANSAS

logic approach called for when piloting a light plane after experience with heavier aircraft is noted. The pilot is reminded of his responsibility and liability in flying civil planes, particularly rented ones, and in respecting local rules and the rights of airport operators. *Aviation*, January, 1946, pages 109–111, 4 illus.

New Planes for Personal Flying. Postwar models of airplanes for the private-flying market are described in nontechnical language, with information about the particular features of each. The flying characteristics, distinctive constructional elements, equipment, and other data are supplied, and the principal specifications are tabulated for 33 types of private aircraft, giving seating capacity, wing design, engine, cruising speed, range, fuel capacity, useful load, landing speed, and approximate price. The tabulation is divided into classes embracing the conventional landplane type, the so-called two-control type, and the amphibians. Estimates are made for the average cost of private flying. It is predicted that buyers will probably purchase from three to five times as many private airplanes this year as in any previous year. *Fortune*, February, 1946, pages 124–129, 154, 156, 158, 10 illus.

Production

Ford-Built Merlins. J. A. Oates. Methods, ideas, and equipment used by the Ford Motor Company Ltd. for the production of Merlin aircraft engines are surveyed. Features of the facilities of the Manchester plant and the layout of its machine shops are reviewed, together with data about its manufacturing procedures, production and gaging machines, labor-training scheme, etc. Among the manufacturing and inspection procedures to which attention is called are those connected with checking of parts for quality and dimensions; machining; production of the steel guide-vane; negative-rake milling and turning; fabrication of the connecting-rod bearing block; valve production; nut slotting; thread generating; and heat-treatment operations. Equipment noted includes a fixture for checking the concentricity of the bore, three bearing surfaces, and the flange of the propeller shaft; Taylor-Hobson Electrolimit units for checking crankshaft pin and journal diameters; a gaging machine built from standard Sigma Signal units for checking external valve dimensions; electrically operated automatic gaging equipment for checking external and internal dimensions on the bottom valve-spring washer; a crank-pin lathe on which all the crankshaft pins are simultaneously and automatically turned; and a Maag spiral gear-grinding machine for finish-grinding the teeth of spiral gears.

Other units described are two types of Michigan gear-shaving equipment, one employing the rotary principle and the other a rack; a Natco deep-hole drill incorporating mechanism for withdrawing the drill after each 0.003-in. feed; double-ended G.W.B. nitriding furnaces used in the heat-treatment of crankshafts; Steinle centerless thread generators; incandescent gas-fired furnaces for hardening and tempering connecting rods; a Birlec rotary-hearth electric furnace for gear-hardening; and a Hannefin quenching press equipped with a die suitably recessed to accommodate the heated gear. In addition to numerous photographs, a table of experimental negative-rake data is included. *Aircraft Production*, January, 1946, pages 7–16, 23 illus.

New Heat Treat Chemicals Replace Critical Materials. William M. Sutherland. The writer describes how the heavy demand for chromium compounds and other products used in the neutralization of heat-treatment baths for aluminum alloys resulted in the discovery of substitute chemicals by the Consolidated Vultee Aircraft Corporation. The chemical properties and application of the bath, as well as the successful results that are stated to have been obtained with sodium acid sulphate, are discussed. *Industrial Aviation*, January, 1946, pages 17, 18, 65, 3 illus.

Uniformity Problems in Heat Treating Aluminum Alloys. Victor Paschkis. The many applications of light metals in which structural uniformity throughout the product is of great importance are referred to. It is noted that the uniformity of the final product will be determined largely by the uniformity of heating and cooling in the various heat-treatments. The meaning of "uniformity" in heat-treating is defined. The greater part of the paper deals with the problem of obtaining thermal uniformity in the furnace charge. *Aluminum and Magnesium*, January, 1946, pages 12, 13, 17, 21, 3 illus.

Blind Riveting in Assembly Work. Lucien Virgile. Seven types of "blind" rivets are described and compared with each other and with so-called conventional rivets. Five types are of American manufacture and two originated in Great Britain. Blind rivets are broadly classified into two general types: (1) those that are activated mechanically and (2) those that are expanded by detonation. The explosive type is represented by the du Pont explosive rivet, and its limitations are outlined. Of the mechanical types, the Preco consists of a steel screw inserted into a hollow-stem aluminum-alloy rivet, with an aluminum-alloy nut threaded onto the end of the screw; the Rivnut is a threaded-core rivet generally made of aluminum alloy in which the pulling tool is screwed into the core; Cherry rivets are made in both hollow and self-plugging types, both kinds being driven and broken off at the stem by a single pulling action. The Huck rivet is described as having important features making it suitable for structural use. A pulling action similar to that of the Cherry expands the shank, forms the blind head, and is followed by a pushing movement that drives a metal lock and breaks the stem. The English Chobert is an accurately machined rivet that depends mainly on expansion of the shank, since only a small blind head is formed. The "pop" rivet is stated to be the most widely used type in England, its action being similar to that of the Cherry rivet. It can be made either hollow or self-plugging, and, since it is generally made of steel, it provides a strength greater than that of the aluminum-alloy rivet of the same size. The writer summarizes the comparison of blind and solid rivets under five headings, noting certain exceptions to the general conclusions stated. *Aero Digest*, January, 1946, pages 66, 106, 9 illus.

Conveyor Transport. B. S. Jelley. The construction and operation of the conveyer system installed at the Gloucester factory of Rotol, Ltd., are described. It is explained how this overhead, continuously moving conveyer system for transporting materials and parts throughout the plant facilitates the manufacture of aircraft propellers. Particular interest is centered around the handling of the parts during assembly. Besides considering the main handling systems, the article also describes the overhead runways with standard chain blocks installed in almost every department for loading and handling heavy material, jigs, and fixtures.

The length of the conveyer in operation at present totals approximately 1,720 yards and consists of three separate sections. The first serves the raw-material stores, heat-treatment department, and No. 1 and No. 2 progress stores; the second serves the same two progress stores but, in addition, feeds the plating and polishing shop and final-inspection department; the third delivers only subcontract components directly to No. 1 and No. 2 finished part stores. A diagrammatic layout of the conveyer system is included. *Aircraft Production*, January, 1946, pages 21–25, 17 illus.

Aviation Reconverts to Peace. Richard O'Connor. Figures are offered to show the extent of reconversion necessitated in the aircraft-production industry by Army and Navy cutbacks. Individual résumés indicate the effects of cancellations and reconversion, the industrial records, and the prospects of the following companies, including total backlogs as of November, 1945: Boeing Aircraft Company; Consolidated Vultee Aircraft Corporation; Douglas Aircraft Company, Inc.; Lockheed Aircraft Corporation; North American Aviation, Inc.; Northrop Aircraft, Inc.; Ryan Aeronautical Company; Curtiss-Wright Corporation; The Glenn L. Martin Company; Bell Aircraft Corporation; United Aircraft Corporation; Republic Aviation Corporation; Grumman Aircraft Engineering Corporation; Fairchild Engine & Airplane Corporation;

Ford Motor Company; and Chrysler Corporation. *Flying*, February, 1946, pages 28, 29, 130, 131, 3 illus.

Fundamentals of Pouring Magnesium Sand Cast Alloys. E. J. Vargo. Foundry problems involved in the melting and pouring of magnesium alloys are discussed. Sections of the article deal with melting procedure, superheating, temperature control, and the pouring box. Defects that may result from malpractice during pouring are enumerated. A magnesium-aluminum constitutional diagram is shown. *Aluminum and Magnesium*, January, 1946, pages 14–17, 2 illus.

Centrifugal Casting Aluminum. The manufacture of aluminum castings by pouring a measured quantity of metal into a spinning mold, or one that is spun immediately after the metal is poured, is described. Sections are assigned to an explanation of the process, the engineering characteristics of the finished product, design characteristics, general manufacturing problems, the mathematics of centrifugal casting, and metal control. *Modern Metals*, January, 1946, pages 14–16.

Aileron Production. The article is concerned with the manufacture of the all-metal aileron for the Hawker Tempest, as it is carried out under subcontract by the Alltools (London Aeroplanes) group. The fabrication and assembly procedures outlined offer a comparison with the aileron-producing methods of the parent firm, reviewed in a previous article. Following an account of the aileron's construction, this study includes information about the production of formed metal parts, the fabricating of the main skin panels and main spar, skin-tensioning methods, the processes involved in various states of assembly, trailing edge locations, etc. Descriptive data relative to equipment employed for the fabrication and assembly processes are supplied. *Aircraft Production*, January, 1946, pages 37–41, 13 illus.

Set-Ups That Solved Nine Borizing Problems. C. G. Nordmark. Machine tool setups that provided solutions to difficult boring problems are described. Two apply to the boring of aircraft parts. These are a setup for boring the bushings in both ends of an aircraft-impeller shaft assembly and a fixture designed to hold an aircraft propeller barrel that must be bored and counterbored. *Machinery*, January, 1946, pages 162–168, 13 illus.

Sodium Silicate Sealing of Aluminum Castings. Because the sodium-silicate system of sealing aluminum castings is not always completely effective, according to tests made by North American Aviation, Inc., an attempt was made to secure additional protection by baking some of the castings. The process is described and the results of the sealing test are tabulated. *The Iron Age*, January 10, 1946, page 63.

A Buyer Looks at Some Foundry Problems. R. V. Elms. A purchasing agent discusses foundry problems and means of reaching a mutual understanding between the buyer and seller of foundry products. He explains some of the requirements for purchase orders and describes the troubles that arise from lack of compliance with specifications. *Aluminum and Magnesium*, January, 1946, pages 18–21, 4 illus.

35 Aeroncas Daily from Mechanized Lines. The quantity-production methods by which Aeronca airplanes are being manufactured are surveyed. Utilizing six conveyer lines, the system is said to produce the following advantages: (1) With constantly moving conveyers, it is necessary to have details and parts that are interchangeable and fit each and every assembly in the same manner—this is important to the man in the field with respect to maintenance and service parts that fit; (2) the system lends itself to good inspection, inasmuch as flaws in parts and assembly can be easily detected; (3) by teaching the worker to do one job and do it well, the system produces airplanes that are consistent and uniform in their assembly; and (4) well-designed pieces in large production runs make possible interchangeability of parts in different models—this is helpful to the man in the field who can stock many different assemblies because one part, in many cases, is either right or left and is interchangeable in several models. *Southern Flight*, January, 1946, pages 42, 44, 4 illus.

Design and Production Technique. Part IV. A. J. Schroeder. A continuation of the fourth part of an article on the mechanical processes used in the production of aircraft parts further discusses the principles involved in drawing. Subjects dealt with are the shaping of stepped parts, the subsequent treatment of parts, factors influencing the degree of precision, etc. *Aircraft Engineering*, December, 1945, pages 363–369, 44 illus.

Propellers

The Future Scope of Propellers. L. G. Fairhurst. An examination is made of the probable scope of aircraft-propeller applications over the next 5 years. Types of propellers anticipated for various future installations of piston and gas turbine engines of 1,000 hp. upwards are treated. Detailed consideration is then given to the aerodynamic and structural problems that face the propeller designer in meeting the demands of the aircraft and engine designers. The paper concludes with a specification of the future propeller and a short forecast of the types of propellers for the smaller types of aircraft. The extensive discussion that followed the reading of the paper is included. *The Journal of The Royal Aeronautical Society*, December, 1945, pages 688–740, 21 illus.

Radio

Army Air Forces' Portable Instrument Landing System. Sidney Pickles. The portable instrument-

G&O
Radiators
31st Year
ENGINE COOLING RADIATORS
•
OIL COOLERS
The G.O Manufacturing Co.
NEW HAVEN, CONNECTICUT

WANTED!
ENGINEER, PHYSICIST
OR
APPLIED MATHEMATICIAN
For research and analysis of the problems of aircraft dynamics, including vibration and flutter. Post-graduate experience in similar work desirable but not essential. Excellent opportunity to acquire responsible direction of particular projects.
Write to
ENGINEERING PERSONNEL DEPARTMENT
CHANCE VOUGHT AIRCRAFT
STRATFORD, CONNECTICUT

landing system for aircraft, developed by the Federal Telephone and Radio Corporation for the Army Air Forces, is comprehensively described. The article is divided into five main parts and five appendixes. The first two sections outline briefly the requirements as set forth by the A.A.F. and as determined by the designers to meet the A.A.F. specifications and include the characteristics of the solid-dielectric, low-loss, dual-shielded, 125-ohm transmission line prepared for the system. The third section contains a detailed analysis of the localizer equipment, defined as that portion of the system which permits the pilot to align the airplane with the runway on which the landing is to be made, constituting the first "contact" with the landing system. The apparatus is mounted in an Army type K53, 2½-ton van-body truck, with all antenna equipment stored on the roof of the truck during transport.

The electrical problems involved in the design of the localizer and its functions are detailed, with regard to the antennas, the array design, and the phasing problems. The reasons for the selection of the mechanical types of modulator are outlined, and the principles of its operation are more thoroughly described in one of the appendixes. Brief descriptions are given of the aircraft localizer receiver, a crystal-controlled six-channel superheterodyne type, with audio system, filters, and dry rectifier. It was built by the Western Electric Company.

The fourth section recounts at length the design and functions of the glide-path system, the principles upon which it operates, and the apparatus used. It is stated that the equisignal type of glide path was selected because it was free of certain difficulties and offered definite advantages through a less complicated antenna system, greater portability, and freedom from the need for such highly trained personnel as was required for previous systems. The glide path is produced by two overlapping radiation patterns, modulated by different audio frequencies, the aircraft receiver being equipped with filters that separate the respective audio modulations. An explanation is made of how a straight-line glide path is obtained and how the angle of the glide path is changed by varying the ratio of the signal amplitudes from the upper and lower antennas. The mathematical calculations for the glide path are set forth, and the other aspects of the antenna system are discussed in full. Further details are presented about the mechanical modulator, output meter, monitoring, the transmitter, test equipment, and the aircraft receiver.

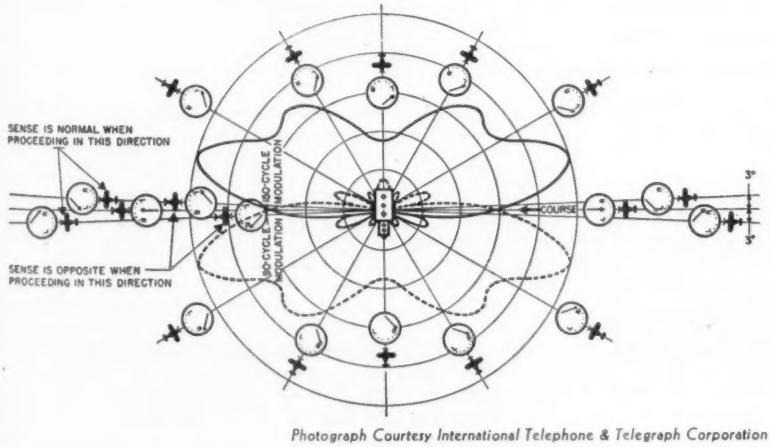
The fifth section discusses the marker beacons and their auxiliary apparatus, which give signals to the pilot regarding the distance from the landing field. The appendixes contain elaborations of the theories upon which the various components of the system are based. *Electrical Communication*, Vol. 22, No. 4, 1945, pages 262–294, 46 illus.; "Instrument Landing Systems, Their Installation and Maintenance," Sidney Pickles, *Aviation Maintenance & Operations*, January, 1946, pages 24, 25, 89–92, 6 illus.

What's Behind Airborne Radar? Part I. Donald M. Skidmore and Charles R. Chambers. Part I of a continued article on radar equipment for aircraft is devoted to electronic units. Development of the cathode-ray tube, the receiver, and the audio amplifier components is reviewed. How lighter transformers were designed is described, and activities leading to the production of light tubes, condensers, and chassis are traced. *Machine Design*, January, 1946, pages 107–110, 6 illus.

Radar-Controlled Talk-Down Landings. Joe James. The design, operation, applications, future commercial potentialities, advantages, and disadvantages of the Ground Control Approach system are explained. Officially known as ANMP-1, Army-Navy mobile radar navigation, the G.C.A. is described as a self-contained mobile unit obtaining its power from engine-driven generators carried on a truck, or from commercial sources. For trailer-to-plane communications, 21 different communication channels are available, including three H.F. and three V.H.F. channels. Two radar systems are provided and three radar antennas are used. One is an ordinary "search" antenna, which covers a 30-mile range; the other two are "precision" antennas that cover only a narrow "sweep." The two precision antennas are used exclusively to give the pilot accurate verbal corrections as he descends along a predetermined glide path. The key to G.C.A. accuracy is said to be contained in the tie-in between the three radar scopes and the actual runway. Peacetime uses for the system are suggested, and its advantages and disadvantages are compared. *Southern Flight*, January, 1946, pages 28–30, 46, 5 illus.

Three Methods. Part VI. S. S. Stevens. The last in a series of six articles dealing with technical aspects of radio and communication in Canadian air transport describes three systems of transmission and reception. These are wired teletype, radio teletype, and wired telephone. The nature, fundamentals, problems, applications, advantages, and disadvantages of each are discussed briefly. *Commercial Aviation*, December, 1945, page 50.

. . . When Jones Says: "My Radio's on the Blink." William A. Burroughs, III. For the benefit of the small airport operator who does not employ a radio-repair technician, procedures are offered for the detection and correction of simple operational troubles in aircraft radio systems. Suggestions pertain to the determination and repair of commonly found deficiencies in the functioning of the antenna system, receiver, transmitter, controls, tubes, bonding, etc. Basic components of an aircraft radio system are listed, and, as an added guide, a schematic drawing illustrates the primary parts of the radio. For the correction of more technical radio troubles, it is recommended that the small airport operator establish an arrangement with a local radio repairman. *Aviation*, January, 1946, pages 92–95, 6 illus.



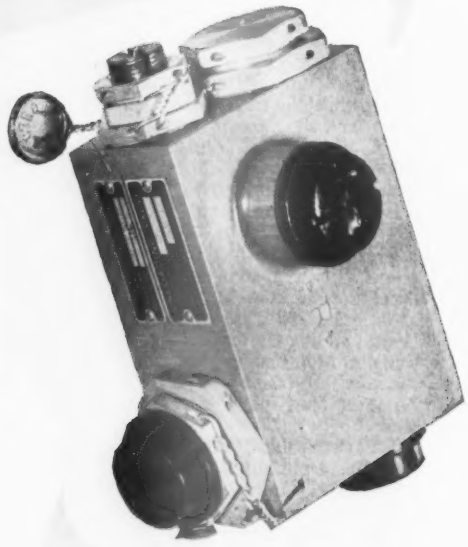
Photograph Courtesy International Telephone & Telegraph Corporation

Localizer course with figures showing readings of the cross-pointer indicator as mounted on the instrument panel of the airplane.

Reaction Propulsion

The Rocket's Future Influence on Transport Designs. Martin Summerfield. Commercial aspects of the application of rocket units to transport aircraft are analyzed with a view toward answering questions regarding the practicability of rocket-assisted take-off, rocket planes for high altitudes, and other characteristics of reaction-propulsion prime movers for postwar civilian use. The differences between the rocket type of power unit, in which all the propulsive gases are self-contained, and other types of jet units, in which the propulsive gases are taken from the surrounding air, are explained, with brief descriptions of thermal jet engines, turbojet engines, the athodyd, and the intermittent jet engine. Rocket units are classified as the powder or solid-propellant rocket and the liquid-propellant rocket. The operating principle of each type is outlined, and the theory of reaction propulsion is interpreted with the

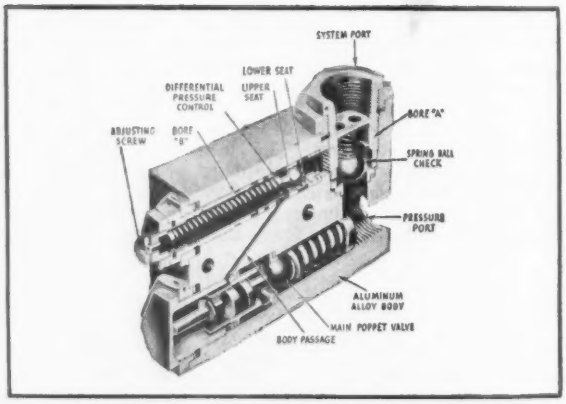
unfailing pressure regulation



ELECTROL'S UNLOADING VALVE

Battle-tested on Navy bombers and fighter planes the ELECTROL unloader valve offers numerous advantages to the aircraft designer. Weighing only twenty ounces, and selling at a remarkably low price, this rugged valve insures safe operation of remote units by maintaining working pressure in the system, relieving the engine-driven pump of this duty. Unloading pressure is adjustable. Through an ingenious system of valves the unit automatically cycles to load and unload, always maintaining the system at the pre-determined state of equilibrium. Construction is to ELECTROL high standards of reliability and performance.

ELECTROL unloader valves are available in six settings ranging from 1,000 to 1,500 lb. per sq. in. Loading pressures range from 800 to 1,250 lb. per sq. in. Specialized requirements can be met by slight modifications. Consult ELECTROL engineers when you design your hydraulic control circuits.



OPERATION... When pressure reaches the pre-set maximum the valve unloads but at the same time maintains pressure in the system. Under these conditions pressure on the lower seat of the controlling valve overcomes the adjusting spring tension moving the valve to the upper seat and allowing flow through the body passage. This causes the main poppet valve to open and the check valve to close. Fluid under pressure is returned to the reservoir and the system is held at pre-set pressure. When system pressure drops below the minimum valve, the differential control valve moves back to the lower seat, the main poppet closes and the check valve opens. Differential pressure is determined by comparative areas in bore "B." Maximum pressure is determined by adjustment screw setting.

ELECTROL, INCORPORATED • KINGSTON, N.Y.

ELECTROL
HYDRAULICS

aid of formulas and figures for computing the thrust and fuel consumption. The favorable features of the rocket are summarized, after which the experiences of the Army and Navy with rocket-assisted take-off are reviewed. The advantages of rocket-power units for high-speed, high-altitude aircraft are shown by comparisons with the power and fuel consumption required by conventional engine-propeller combinations and turbojet units to develop equivalent thrust and speed under the given conditions. Tables and charts clarify the explanations and opinions offered. *Aviation*, January, 1946, pages 73–76, 4 illus.

Jato and Civil Aviation. As demonstrated by the Aero-Jet Engineering Corporation, the commercial possibilities of jet-assisted take-off for aircraft are envisioned. It is claimed that "jato" will allow take-offs not only from smaller airports but also from airports located at higher altitudes; that any airplane regardless of size can take off with jet assistance from any field on which it is able to land; and that the use of jet-assisted take-off for light planes enables owners to take off from small airfields or emergency spots that are adequate for landing but not large enough for take-off with ordinary power. Jet assistance makes it possible for the light amphibian or seaplane to take off from small lakes, high-altitude lakes, or other small bodies of water where ordinary engine power is insufficient for the take-off; jet assistance for gliders eliminates the necessity of using tow planes or cars; "jato" adds to the safety of taking off an airplane having a high wing loading. The design, operation, and application of the standard Aero-Jet solid-propellant engine are described in this article. *Southern Flight*, January, 1946, pages 32, 33, 3 illus.

Jet Gen. Squadron Leader T. S. Wade. The writer discusses some of the characteristics, problems, and factors of jet-propelled aircraft. The influence of jet engines upon the design of the aircraft and the handling characteristics of jet-propelled planes are considered. For the purposes of these impressions, the Gloster Meteor is taken as representative of that type of airplane. *The Aeroplane*, January 4, 1946, pages 18, 19, 3 illus.

The Junkers Jumo 004 Jet Engine. Design features of the German Jumo 004 jet engine, as revealed through a critical examination of the power plant, are described in detail. A design analysis is made of the nose cowling and intake casting, compression and central casting, combustion chamber and turbine nozzle, turbine exhaust system, and cooling-air system. Specifications of the compressor blade are tabulated. Diagrams show the general arrangement of the complete unit, the cooling-air system, and the compressor thrust bearing. Photographs of the engine and some of its components are included. *Aircraft Engineering*, December, 1945, pages 342–347, 23 illus.

How Nazis' Walter Engine Pioneered Manned Rocket-Craft. Roy Healy. An analysis of the construction and operational features of a German rocket power plant, the Walter 109-509, includes a review of the design characteristics of two fighter planes in which the unit was installed, the Me 163 and the experimental Bachem BP-20 Natter. Capable of approximately 3,800 lbs. peak thrust, the Walter 109-509 (also known as the HWK 509) is indicated as symbolizing German design ideas on power units for high-speed interceptors. It consists of two subassemblies—the rocket engine and its accessory section—separated by approximately 4 ft. of connecting tubing running through a sheet-metal conduit. Empty of propellants, the unit weighs about 220 lbs. A schematic diagram of this German rocket power plant, photographs, and a table of fundamental design data of the two aircraft fitted with the 109-509 supplement the text. *Aviation*, January, 1946, pages 77–80, 4 illus.

Rocket Efficiencies. E. Burgess. The future possibilities of rocket drive for aircraft are evaluated, and an examination is made of the overall efficiency that can be expected from the rocket engine. The thermal efficiency of rocket motors is discussed in sections dealing with combustion-chamber efficiency, the ideal isentropic efficiency, and nozzle efficiency. A study is then made of the propulsive efficiency or efficiency with which the energy made available by the thermal process is converted into useful work. It is concluded that it will be necessary to use jet-propulsion power units with turbocompressors if high efficiencies are to be obtained and if the fullest use is to be made of jet reaction. *Aeronautics*, January, 1946, pages 46–49, 3 illus.

Reconversion

Reconverting for Competitive Markets. Douglas Hodges. The results of a reconversion survey of the major aircraft companies in Southern California are reported. It is stated that the survey reveals quality as the universal aim of reconversion programs but reflects sharply the varying factory policies that constitute the formulas for achieving those aims. Conclusions reached from a composite view of prevailing practices are enumerated. Shop policies, which differ widely, are described. *Industrial Aviation*, January, 1946, pages 22–24, 54, 55, 3 illus.

Research

Flame-Temperature Measurements in Internal-Combustion Engines. O. A. Uyehara, P. S. Myers, K. M. Watson, and L. A. Wilson. The paper deals with the theory, development, and calibration of an electro-optical pyrometer, capable of determining instantaneous true temperatures of luminous flames. An auxiliary apparatus is described which is used with the electro-optical pyrometer to obtain simultaneous values of pressure, temperature, and crank position in an internal-combustion engine. Typical data obtained with this instrumentation as applied to a Diesel engine are included. *Transactions of the A.S.M.E.*, January, 1946, pages 17–30, 22 illus.

A Cylinder Cooling Problem. Samuel A. Schaaf. It is noted that the linear cooling problem for nonhomogeneous solids has been investigated extensively by W. M. Rust, Jr., R. V. Churchill, H. S. Carslaw, W. A. Mersman, and others. A solution for the corresponding cylindrical problem is presented. The method used is that of the Laplace Transform. *Quarterly of Applied Mathematics*, January, 1946, pages 356–360, 2 illus.

The Behavior of a Hot-Wire Anemometer Subjected to a Periodic Velocity. R. C. Martinelli and R. D. Randall. The writers describe a method that allows a rapid graphic prediction of the response of the constant-current hot-wire anemometer to a periodic velocity. From such a prediction the suitability of the hot-wire anemometer for any particular application can be readily determined. The method is demonstrated by several illustrative examples. *Transactions of the A.S.M.E.*, January, 1946, pages 75–79, 7 illus.

Analysis of Numerical Solutions of Transient Heat-Flow Problems. Clarence M. Fowler. Formal methods for establishing the convergence of numerical solutions of transient heat-flow problems are presented. Expressions for these solutions are derived in terms of initial temperatures and boundary values. *Quarterly of Applied Mathematics*, January, 1946, pages 361–376, 3 illus.

German Jet Developments. Sir Roy Fedden. Separated into two parts, the final article of a series of three reporting on the findings and observations of a member of a British technical mission to Germany contains a review of developments in German jet-engine components. Part I calls attention to the obstacles that had to be overcome by the Germans because of material shortages, as well as to German concentration on axial-flow arrangements. It surveys details of the Jumo 004 engine and compressor unit, the B.M.W. 003 compressor and turbine, and the B.M.W. 018 engine. In addition, specifications are supplied relative to the projected B.M.W. 3306 and 028 designs. Tables of data are shown for the B.M.W. engines.

Part II deals briefly with jet projects undertaken by Heinkel-Hirth, Daimler-Benz, A.E.G., and Brown-Boveri. General remarks summarize the German attitude toward jet engines, the approach used for developing them, and the progress made. Drawings and tabulations clarify the reported observations. *Flight*, December 13, 1945, pages 626–629, 19 illus.; December 20, 1945, pages 661, 662, 5 illus.; "The German Jet," by Sir Roy Fedden, *National Aeronautics*, December, 1945, pages 13, 14, 2 illus.

Tremendous Transports need tough "legs"

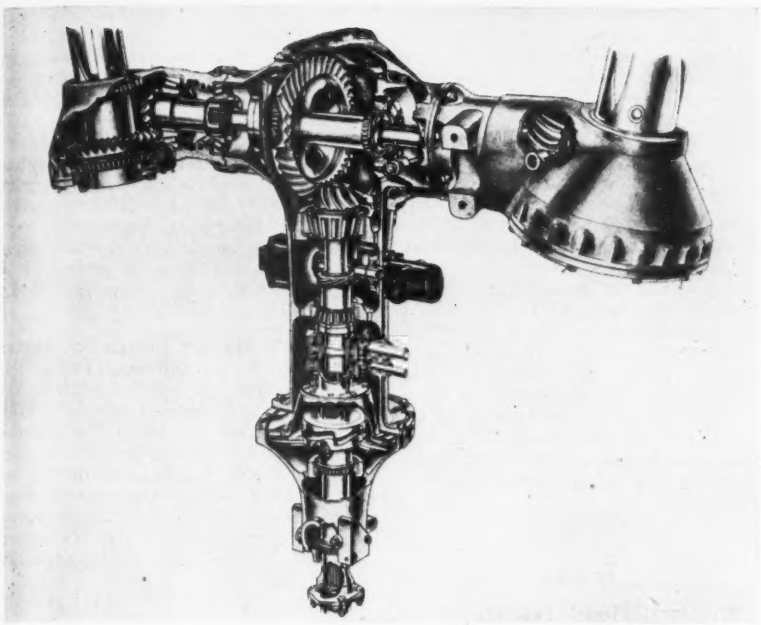
Illustrated is the 155,000-pound Douglas C-74 "Globemaster" that can fly to almost any point in the world. Because this tremendously heavy transport requires landing gear of outstanding efficiency and reliability, it is equipped with Cleveland Pneumatic Aerols. ● Other leading transport planes as well as the "Globemaster", are Aerol-equipped. This widespread preference for Aerols is due to their long record of proved performance — *for almost 20 years, on all sizes of planes,* Aerols' smooth shock absorption has insured safety and comfort in landing.

THE CLEVELAND PNEUMATIC TOOL CO.

AIRCRAFT DIVISION • CLEVELAND 5, OHIO

AEROLS*

*PNEUMATIC-HYDRAULIC (AIR-OIL) SHOCK ABSORBING LANDING GEAR



A cutaway illustration of the transmission of the Kellett XR-8 helicopter.

Rotating Wing Aircraft

Principles of Rotary Wing Aircraft. Part VIII. Alexander Klemin. In the eighth and concluding part of a serial article, the flapping equation is presented in elementary form, and equations are derived for thrust, torque, and longitudinal force. The necessary trigonometric relationships are explained, followed by the derivation of the collection of expressions for the forces of the rotor and the pertinent coefficients. The forces are defined as the Longitudinal Force, the Lift, the Lateral Force, and the Propulsive or Drag Force. The mathematical expressions are worked out for each of these forces, and the writer then considers the equation of moment equilibrium about the flapping hinge. The equation is translated into physical terms showing that the blade is at any instant in equilibrium with (1) the thrust moment acting to raise the blade; (2) the weight tending to depress the blade; (3) the centrifugal force tending to depress the blade; and (4) the dynamic reaction due to flapping, tending to depress the blade as long as the angular acceleration is upwards.

Stating that the equation helps to determine the moment at the root of a rigidly held blade, the writer explains how the thrust of a rigidly held blade can be determined without coning, as an introduction to the more complicated problem of the thrust of a flapping blade. The computation of the thrust of a flapping rotor is made in a similar manner with the exception that the velocity caused by flapping must be taken into consideration. Comments are made about the employment of a flapping hinge. The series concludes with eight examples to be worked out by the reader, with suggestions for steps to be taken to facilitate the solutions. *Aero Digest*, January, 1946, pages 52, 53, 113, 115, 5 illus.

Auto-Pilots for Helicopters. M. F. Bates. Problems connected with the application of the automatic pilot to helicopters are considered. Information gained by the Coast Guard Research Laboratory through the installation of an experimental autopilot in a helicopter is briefly described. *American Helicopter*, January, 1946, page 24.

How to Fly the Helicopter. Jack Charleson. A report of the handling and flying characteristics of the helicopter. The writer's impressions and recommendations are reviewed under the following headings: in the cockpit; rudder pedals; main pitch-control lever; clutch lever; control sticks; take-off procedure; handling in flight; landing procedure; ground handling; high tip speed; safety factor; what about engine failure; can you fly blind; and what about the future. *Canadian Aviation*, January, 1946, pages 24–26, 54, 4 illus.

Human Engineering in the Helicopter Cockpit. Lt. Comdr. J. L. Baker. The writer makes a plea for an engineering solution to medical problems found in the basic controls and elementary cockpit features of helicopters. It is stated that the helicopter, like other aircraft, is only as efficient and safe as the efficiency and dependability of the human reactions of the individual operating the controls and that a distinction should be made between the coordinated control movements an individual can learn to perform and those he will perform safely in an emergency. Various psychologic problems connected with the control of helicopters are discussed. *American Helicopter*, January, 1946, pages 17–19, 44, 45, 8 illus.

Standardization

Applied Finishes Standardization and Basic Principles of Procedure. S. B. Ashkinazy. Principles and practices underlying the selection and establishment of standards for applied finishes are described, with particular reference to the engineering and manufacturing requirements of the Sperry Gyroscope Company, Inc. Other phases of standardization discussed include specifications for procurement, application, and inspection and publicizing the standards to encourage their use. Typical forms for purchase specifications and manufacturing specifications for finish are shown. *Product Engineering*, January, 1946, pages 24–28, 5 illus.

Stress Analysis

A Buckling Problem. J. Ratzersdorfer. An elastically supported continuous beam with an even number of spans is studied. The spans are each of the same length, have a constant cross-sectional area, a constant moment of inertia about the axis of buckling, and are subject to a compressive force. The elastic stiffnesses of all intermediate supports are equal; the elastic stiffnesses of the two end supports are also equal but generally different from those of the other supports. Equations are derived for determining the buckling condition for the beam and the relationship between the critical load and the elastic stiffness of the supports. *Aircraft Engineering*, December, 1945, pages 348–351, 353, 8 illus.

Charts for Fuselage Torsion Versus Control-Surface Flutter. W. T. Thomson. Charts are presented for evaluating the allowable unbalance in the control-surface product of inertia for tail flutter involving fuselage torsion. The basic theory, assumptions, and limitations are discussed in detail. *Transactions of the A.S.M.E.*, January, 1946, pages 51–56, 9 illus.

The Specification of Test Loads. A. G. Pugsley. It is observed that when strength tests were first made on airplane structures the primary object was to find the load that, when gradually applied to the structure, just broke it. Reference is made to difficulties encountered when, at a later stage, attempts were made to define a "proof" load at which the structure, because of its deformation or other damage, just ceased to be regarded as airworthy. It is stated that because of these difficulties reliance has continued to be placed on measurements of ultimate load, despite the increasing realization of the relatively great importance of the proof load. With the greater knowledge that has been gained of flight loads and of structural accidents, the writer makes a new approach to the general problems of specifying test loads. A series of proposed test conditions is outlined and summarized in tabular form. Sections of the article are assigned to fatigue in level flight, high maneuvering loads, oft-repeated maneuvering loads, ultimate

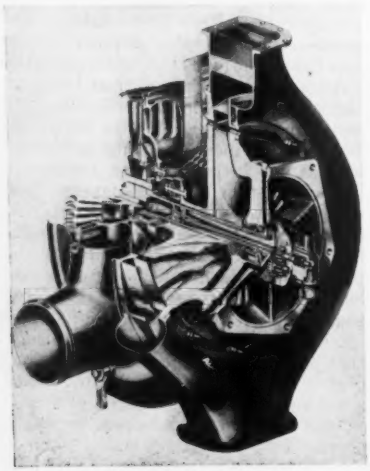
strength, and the scatter of test results. *Aircraft Engineering*, December, 1945, pages 352, 353, 1 illus.

Proof Stress Determination. R. A. Beaumont. Because it was realized that the ability to determine proof stress without plotting a stress extension graph would provide many advantages in routine testing, a new approach to proof stress determination was made. This led to the development of the method for rapid routine testing described by the writer. It is stated that the method is particularly suitable for the new self-indicating dial-type testing machines but also can be rapidly applied to steel-yard types. The method involves developments in extensometer application which are explained in detail. The testing of large and small specimens is described. A diagram illustrates the construction of the Beaumont proof stress determination chart for an aluminum-alloy test bar. *Aircraft Production*, January, 1946, pages 42–51, 18 illus.

The Stresses in the Wall of a Duct. W. G. Webber. A study is made of problems of duct design which the designers of aircraft power plants have had to meet with the introduction of auxiliary blowers and the fashion for wing-entry air intakes. It is observed that aerodynamic aspects of duct design have been thoroughly investigated but that little work has been carried out on the strength of air ducts, a subject that is important because the power lost by the engine through duct failure may be considerable and may lead to disastrous results at high altitudes. An analysis is made of the effects of pressure rectangular ducts. The solutions obtained are not claimed to be complete but are believed to demonstrate a possible approach to the complex problem. *Aircraft Engineering*, December, 1945, pages 355–358, 13 illus.

Superchargers

Bearing Design and Installation in High-Speed Superchargers. Zola Fox. The fundamental design requirements for high-speed supercharger bearings and methods of lubricating the bearings are considered. The loads on supercharger bearings are analyzed. The advantages and disadvantages of ball, roller, and plain bearings are discussed. Types of floating bushings, nut locking devices, and thrust-collar details are described and illustrated. Sectional views of high-speed superchargers are shown. *Product Engineering*, January, 1946, pages 8–11, 7 illus.



The internal structure of Wright Aeronautical Corporation's turbosupercharger. The supercharger is no larger than a hatbox.

Separation in Aero-Engine Supercharger Impellers. G. G. McDonald. An approximate formula is derived for estimating the degree of separation—that is, the extent to which the fluid loses contact with the blades—in supercharger impellers. An example of the application of the formula to a practical case is given. *The Australasian Engineer*, November 7, 1945, page 78, 1 illus.

Testing

Structural Model Testing. O. W. Loudenslager. Precise structural model design, construction, and test procedure are discussed. The writer states the laws of similarity to which all structural models must conform if precise results are to be obtained in the simplest manner. Scale selection, choice of materials, and construction methods are considered. Three model members, of designs that can represent a number of prototype properties, are described in detail, as well as the use of each of these members and the determination of bending, torsional, tensile, and compressive stresses by means of simple equipment. In addition, design formulas are included for a member that represents the axial, torsional, and bending (in two planes) properties. Three test procedures, all applicable to a variety of simple or complicated indeterminate structures, and the methods used in evaluating the test results are described. *SAE Journal*, January, 1946, pages 18–25 (Transactions), 9 illus.

Testing Equipment

The Aerodynamic Balancing of Propeller Blades. George H. Tweney. The writer describes a machine for the calibration of propeller blades so that the overall aerodynamic errors are determined rapidly by mechanical means. The apparatus was originally designed by engineers of Rotol, Ltd., Gloucester, England, but was brought to the United States early in 1944, and license to manufacture and operate the complete apparatus was given to the Wickman Corporation of Detroit. The design of the machine and the principle on which it operates are presented. *Industrial Aviation*, January, 1946, pages 36, 37, 65, 2 illus.

Engine Test Cells. Lee J. Bregenzer. The design, construction, and operation of aircraft-engine test cells are reviewed. It is pointed out that the design of this type of equipment is a highly specialized subject and involves a thorough understanding of acoustical treatment, building design, plumbing and electrical design, and the selection of proper precision instruments. Other topics considered are the selection and layout of buildings and cells for testing air-cooled and liquid-cooled engines. Plans of typical layouts are shown. Additional suggestions are made concerning the selection and installation of equipment. *Aviation Maintenance & Operations*, January, 1946, pages 19–23, 83–85, 9 illus.

MCA's Modern Design for Engine Testing. R. L. Sullivan. The article describes the test building built at the Minneapolis Maintenance base of Mid-Continent Airlines, Inc. The facilities were provided to take care of the increasing volume of engines being overhauled at the base. Details are supplied about the test cell, control room, utility room, and the equipment. *Air Transport*, January, 1946, pages 47, 48, 51, 52, 6 illus.

Tools and Equipment

Oil Spray Collection. Brief notes tell of a special unit that was devised to prevent the factory-wide spread of an oil mist caused by the oil spray and vapor emitted during machining processes. Developed by Dallow Lambert & Company, Ltd., the motor-driven oil-collecting unit is located above each machine. It incorporates special impingement-type filters and operates so that the resulting precipitant is drained back into the oil tank of the machine. Hygienic and economic benefits derived from the use of the unit are indicated. *Aircraft Production*, January, 1946, page 6, 1 illus.

Training

Retraining the G. I. Mechanic. Phillips J. Peck. An account of the training courses available to A.A.F. mechanics to equip them for civilian jobs outlines the program of off-duty courses that are designed to prepare both officers and enlisted men to pass C.A.A. examinations for A and E certificates. Training at Bolling Field is the "model" for the new program. *Flying*, February, 1946, pages 33, 34, 134, 2 illus.

". . . Now You Follow Through." Capt. John G. Jenkins. Condemning the system of flight instruction which encourages passive acceptance upon the part of the student, the writer cites the best method of teaching as the one in which the student knows what he is going to do—and why and then actively tries to do it. A routine outlined as a good pattern to follow in teaching flying is one originally used in the Air Services gunnery courses: First, make sure that the student knows what he is going to accomplish—and why; second, make sure that he knows, step by step, how he is going to do it; third, give him every possible opportunity to do the thing

himself; fourth, correct his mistakes as they are made; fifth, keep his skill alive by repeated refresher courses under supervision, intended to keep him performing well and to prevent bad habits from developing. *Air Facts*, February, 1946, pages 31–36.

Flying Gets Its Ph.D. Gene Slack. Research work in the art of flight instruction, which has been under way since 1939 as part of the pioneering research program of the National Research Council Committee on Selection and Training of Aircraft Pilots, is outlined.

The writer describes how flight training has been undergoing careful scientific analysis. He explains the way laboratory methods are being used in the effort to obtain additional safety. *Air Trails*, February, 1946, pages 38, 39, 64, 4 illus.

A photograph of a Solar Aircraft Company's engine manifold taken at night with no other lighting than that radiated by the manifold. The manifold, which was installed on a Wright R2600-8 radial engine, was at a temperature of approximately 1,400°F. The manifold pulsates approximately 18,200 times per min. at the maximum r.p.m. of the engine, because of the opening and closing of the exhaust valves.

Welding

The Flash Welding of Alclad 24S-T Alloy in the 0.064-in. Thickness. W. F. Hess and F. J. Winsor. A preliminary investigation of the flash welding of aluminum alloys, conducted at the Rensselaer Polytechnic Institute, is reported. The investigation was undertaken with existing equipment to provide a background for a more extensive investigation when higher capacity and more versatile equipment becomes available.

Efforts were made to determine the effects of the fundamental flash-welding variables on the quality of welds in Alclad 24S-T alloy and to determine optimum combinations of these variables. The investigation was limited to 24S-T aluminum alloy, principally in the 0.064 in. thickness. The welding equipment used for the tests is described. Particulars are included about the effect of the time relationship between upset and current cut-off, and about the effects of upset travel and power level. Brief comments are made about the flash welding of 0.081 and 0.102 Alclad 24S-T.

The conclusions drawn from the investigation are summarized. *The Welding Journal*, January, 1946, pages 9-s–20-s, 10 illus.

An Investigation of Current Wave Form for Spot Welding Alclad 24S-T, 0.020 In. in Thickness. W. F. Hess, R. A. Wyant, and B. L. Averbach. The report describes the first of a series of investigations of current wave form for spot welding aluminum alloys, which was conducted at the Rensselaer Polytechnic Institute. Two wave forms were investigated and the welding was limited to 0.020-in. Alclad 24S-T. Two methods of surface treatment were studied, one consisting of wire brushing and the other of chemically treating to produce the desired surface resistance and at the same time retain the bright mill finish.

As a result of the investigation a number of conclusions were drawn, some applying to current wave form and some to other variables. *The Welding Journal*, January, 1946, pages 20-s–29-s, 14 illus.

Resistance Welding on Stainless Steel Aircraft Engines and Accessories. Frank G. Harkins and W. L. Hales. Interesting applications of resistance-welding processes to the manufacture of stainless-steel airplane components are described and illustrated. Comments are made about the performance of the various operations. The parts illustrated include components of manifolds, heat exchangers, cowlings, and jet engines used in modern commercial and military airplanes. Inspection, testing, and control problems connected with the manufacture of these accessories are discussed. *The Welding Journal*, January, 1946, pages 39–46, 24 illus.

Miscellaneous

"All We Know Is. . . ." W. W. Ward. A protest against the misleading newspaper reports of airplane accidents, which, it is charged, hinder public acceptance of aviation. The writer claims that all too often newspaper accounts of airplane accidents imply that the blame lies with the structural deficiency of the airplane rather than with the inefficiency or carelessness of the individual pilot. As one remedy for this type of harmful reporting, he suggests that airplane and engine manufacturers, gasoline and oil companies, accessory manufacturers, and aircraft operators start on a campaign to educate the representatives of the press to a better understanding of what makes an airplane fly and what makes it fail. *Air Facts*, February, 1946, pages 9–16.

Revelations at Farnborough. Part II. Concluding half of an article surveying the British and German aircraft, engines, and auxiliaries displayed at the Farnborough exhibit. Part II includes in its review details of the Martin-Baker F-18/39, the Olympia sailplane, the Horten IV sailplane, and a number of German aircraft and engines. Among the German exhibits mentioned are the He 162 Volksjaeger, Me 262H4, Walter rocket unit used in the Me 163, Dornier 335, Blohm and Voss 155, FW 190, FWTa 152, FW 200, Ju 52, Ju 352, Arado 234-B-2, and Me 163B. *Flight*, November 15, 1945, pages 523–526, 15 illus.; "German Aircraft Exhibition, Parts I and II," *The Aeroplane*, November 16, 1945, pages 568–571, 13 illus.; November 23, 1945, pages 591–593, 13 illus.; Part III, November 30, 1945, pages 619–622, 12 illus.

Flying Boats

C. H. Schildhauer

(*Continued from page 9*)

used in our everyday life and in a competitive nature for efficient utilization. Our industry must be prepared to meet our national needs, for the next time there will be no M-day plus. Preparedness through research by other countries will rub out the "plus" that saved us in World War II. We must admit that the enemy was ahead in research in supersonic speeds, rockets, and jet propulsion. Even the atomic bomb was almost in the hands of the Nazis. That is why I say the development and use of the flying ship must be considered as part and parcel of our national preparedness in offense or defense and in the promotion of air transportation to cement relations for peace in the world of tomorrow!

Wave Makers

"A leaping trout awakens the still pool to life in waves that move in silent rhythm."

In the same way, when you speak over the telephone, vibrating electric currents speed silently away with the imprint of your voice over the wire and radio highways of the Bell System.

Tomorrow, the vibrations will be the living pictures of television. All are examples of wave motion.

How to produce, transmit and receive electrical wave motion is the basic problem of the communication art.

Bell Telephone Laboratories, which exist primarily to invent and develop better communications for the Bell System, devote the teamed efforts of physicists and mathematicians to the production and control of electric waves in all forms.

Out of these fundamental studies have come the discoveries which keep the Bell System at the forefront of the communication art.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR THE CONTINUED IMPROVEMENT OF TELEPHONE SERVICE

Government Publications

Army Air Forces

Institute of Technology at Wright Field. Announcement has been made of the opening of the newly activated Institute of Technology at Wright Field, at which classes will begin in September, 1946. The present Army Air Forces Engineering School will close upon graduation of its last wartime class in April. It is planned to establish the A.A.F.'s newest educational center in a $700,000 development adjacent to the Wright Brothers Memorial in the Hilltop area at the field. A group of two-story brick and concrete buildings will be flanked by an auditorium having 1,000 seats. The northern sections will house a complete aeronautical library, which will be connected through a wing with a series of classrooms and completely equipped laboratories to serve as workshops for the practical study of advanced research problems.

The Institute of Technology will take up the work of the Engineering Center on a much larger scale. Its course will run for 1 year, with two 24-week terms, separated by short vacations. In long-range peacetime operation the Institute will offer postgraduate work to selected A.A.F. men who have completed engineering studies in civilian universities. By means of field trips to aircraft plants and laboratories in the United States and with the existing full-scale laboratories at Wright Field available for further study, the Institute will offer facilities for well-rounded studies of the aeronautical sciences. In addition to the refresher courses in basic and advanced aeronautical theory, as given in the wartime engineering school, the Institute will extend its work to such additional subjects as logistics, engineering administration, maintenance, and procurement. *Air Technical Service Command.*

Surplus Airplane Fuel and Oil Cells Offered for Public Sale. It has been decided to offer for retail sale large quantities of airplane fuel and oil cells which have been declared surplus war property. The tanks are stated to be suitable to conversion for many uses. They are composed of three-ply synthetic rubber and vary in size, shape, and capacity, ranging from the fuel tank for a P-39 fighter, measuring 10 by 23 by 10 in., to one for a B-29 bomber measuring 122 by 32 by 56 in. Their capacity ranges from 3 to 700 gal.

Retail sales to individuals were scheduled to begin January 30 at 150 A.A.F. installations in various parts of the country. *Air Technical Service Command.*

Civil Aeronautics Administration

Flight Engineering Report No. 18, "The Effect of Power Upon Calculated Airplane Climb Performance," is now available for distribution upon request. It is a supplement to Flight Engineering Report No. 3, in that it discusses the correlation of test and calculated climb performance when the engine power is varied and was prepared for the purpose of showing what should be taken into consideration when demonstrating the take-off climb performance required by the present Civil Air Regulations.

The investigation consists of the analyses and discussion of the data obtained from three series of sawtooth climbs conducted in a twin-engined transport airplane at various power conditions which were reduced to polar form to determine the effect of power upon the calculated airplane parameters. *Safety Regulation Release No. 196*, January, 1946.

History and Development of the Ohio State Flight Inventory. Part II: Recent Versions and Current Applications. The history and development of the Ohio State Flight Inventory through 1941 have been discussed in C.A.A. Division and Research Report No. 47 (AERONAUTICAL ENGINEERING REVIEW, December, 1945, page 91). The present report describes subsequent revisions of the Ohio State Flight Inventory and includes data resulting from the use of these revisions for criterion purposes in studies conducted by the Committee on Selection and Training of Aircraft Pilots.

Part II of the report continues with the history and development of this technique and form for recording and grading flight performance. It describes the 1942 version and the current version with its present applications. The current version of the Ohio State Flight Inventory is essentially the short form of 1942 version, with the addition of a few items considered to be of diagnostic value and improved format by printing items representing satisfactory performance in blue and those representing unsatisfactory performance in red. The report describes each version, particularly the nature of the revisions by comparison with previous versions, indicates methods of scoring, and gives data resulting from its use in research problems.

Use of the inventory by field and research personnel has been facilitated through preparation of a *Manual for the Field Administration of the Ohio State Flight Inventory*. The second edition of the *Manual* embodies modifications suggested by members and the staff of the Committee on Selection and Training of Aircraft Pilots and suggestions resulting from field trials by instructors. In addition to general directions for the use of the *Manual*, there are specific directions for marking each sheet for the various flight maneuvers, and a standard check flight is outlined. The report was prepared by the National Research Council Committee on Selection and Training of Aircraft Pilots. *Civil Aeronautics Administration, Division of Research, Report No. 51*, November, 1945.

Methods of Finding Private Pilots Lost in Wilds. Arrangements set up by the Civil Aeronautics Administration and approved by the Non-Scheduled Flying Advisory Committee provide means for reporting any cases where private pilots are forced down in rugged or sparsely settled territory. The plans place the communication facilities of the Civil Aeronautics Administration at the service of any private pilot who files with any C.A.A. communications station a plan for the flight he proposes to make. According to the plan the estimated time of arrival of the pilot at his destination is the key item of the flight plan. If he fails to arrive within 2 hours of his estimated arrival time, the C.A.A. communications operator at his point of departure makes contact with the operator at the point of destination. If he does not arrive within 4 hours, an actual search is started. *Civil Aeronautics Administration, Office of Aviation Information.*

C.A.A. Inspectors to Use Navy Surplus Planes. It has been an-

nounced by T. P. Wright, Administrator of Civil Aeronautics, that surplus Navy SNJ-3 planes, also designated by the Army as AT-6, will be used by Civil Aeronautics Administration Inspectors, particularly those who cover large areas on regular itineraries. Each airplane carries two persons and has ample capacity for the supplies and equipment that inspectors must carry in their travels. *Office of Aviation Information.*

Civil Aeronautics Board

Statistics for Selected World Air Carriers. Compiled by Bernard Myers. This 156-page book contains statistics with regard to mileage and traffic, descriptions of routes and equipment, miscellaneous operating and organization data for transoceanic air carriers operating during the past 15 years. The statistics were originally gathered from several hundred sources to supply background data for the Overseas Air Service Patterns study series. The collection includes a comprehensive selection from all of the data resulting from the work performed.

Both summary-system data and detailed route data for 1938 are presented for most of the air lines involved. In certain cases, because of the lack of data for 1938, it has been necessary to substitute an earlier or a later year. All major foreign air lines are included in the report.

The first section contains a summary of 1938 mileage and traffic statistics for selected world carriers, giving a summary by continent, country, and carrier of available mileage and traffic statistics for world air carriers operating as of 1938 or the nearest year thereto for which comparative data are available. The second section includes statistics for selected world air carriers in operation between 1937 and 1944, comprising tables for each carrier with regard to several years of operation and including descriptions of routes and equipment, mileage and traffic statistics, as well as miscellaneous organization data. The carriers are listed alphabetically within each geographical subdivision, these subdivisions being Africa, Asia, Australasia, Europe, Middle America, North America, and South America.

The third section gives descriptive data for transport aircraft in operation on world air routes from 1937 to 1944. The fourth section contains a conversion chart for weights and distances, showing the equivalents in American pounds and miles of the metric system of weights and distances used in foreign countries. Route maps for world air carriers in the various geographical subdivisions constitute the fifth section, and an alphabetical index of the air carriers gives the nationality and the page numbers where information concerning the carrier is to be found. *Civil Aeronautics Board, Economic Bureau, Analysis Division,* November, 1945.

Part 03, Airplane Airworthiness: Normal, Utility, Acrobatic, and Restricted-Purpose Categories. Civil Air Regulations Amendment 03–0, effective November 13, 1945, is published in pamphlet form comprising 105 pages and is divided into seven principal sections. The first section deals with the scope of the regulation and other sections include detailed instructions regarding flight requirements; strength requirements; design and construction; power plant installation; equipment; operating limitations and information; and identification data. Subsections under each of these sections explain the requirements. Numerous sketches and charts are inserted to clarify the regulations. *Civil Air Regulations Amendment 03–0,* effective November 13, 1945.

Part 04, Airplane Airworthiness: Transport Categories. Civil Air Regulations 04–0 effective November 9, 1945, is a pamphlet of 115 pages prepared in similar form having the same principal categories as Part 03 but referring to aircraft to meet the airworthiness requirements for air-transport service. Airplanes are classified on the basis of their intended operation into two main categories, the first referring to transport aircraft that must be of multiengined type limited to nonacrobatic operation and intended for, but not limited to, scheduled passenger, cargo, or combined passenger and cargo-carrying operations. The second category is classified as restricted, in which the airplanes are intended to be operated for restricted purposes not logically encompassed by the transport category. The requirements of this category shall consist of all of the provisions for the transport category which are not rendered inapplicable by the nature of the special purpose involved, in addition to suitable operating restrictions that the Administrator finds will provide a level of safety equivalent to that contemplated for the air-transport category. *Civil Air Regulations Amendment 04–0,* effective November 9, 1945.

Department of Agriculture

Florida's Production of Agricultural Perishables in Relation to the Development of Air Freight. A report is made of a survey undertaken by the Bureau of Agricultural Economics of the Department of Agriculture and the Edward S. Evans Transportation Research with regard to the transportation of certain agricultural and horticultural products from Florida to markets in other parts of the country. The report presents statistics on the seasonal production of fruits and vegetables in Florida and shows how air operations might be utilized. It contains data in text, tables, and charts concerning the production of various agricultural commodities and outlines a pattern for air-freight operations. *Bureau of Agricultural Economics.*

Thousands of New Names in New Places in Aviation

The new blue edition of the Directory is the second revision since war's end. It has listings of all persons and organizations in their peacetime roles.

This latest revision contains newly appointed dealers and distributors of aircraft, air cargo operators as well as up-to-date information on air lines and manufacturers.

An Essential in Your Office . . . Invaluable on the Road

This Spring-Summer edition of the Blue Directory is the thirteenth completely revised issue since the inception of the publication six years ago. Today's standard reference for the aircraft industry. For the first time we have included a listing of dealers and distributors of aircraft and a section listing the growing number of Air Cargo and Charter operators. A copy of American Aviation Directory in your brief case or on your desk places indispensable facts about this market at your finger tips.

NEW SPRING-SUMMER (BLUE) EDITION $5.00
WITH THE FALL-WINTER (RED) EDITION $7.50

SEND COUPON TODAY

American Aviation Associates, Inc.
340 American Building
Washington, D. C.

I enclose check for the new Blue Edition—$5.00 ☐
Send me both Editions—$7.50 ☐
I enclose check ☐ Bill me on shipment ☐

Name _____

Address _____

City _____ State _____

New York State Department of Commerce

Digest of New York State Laws Affecting Aviation. A 10-page leaflet summarizes the statutes of the State of New York which most directly concern those interested or engaged in aviation. While there are laws affecting aviation in many of the State's penal, tax, and other statutes, the bulk of the State legislation of interest to airport operators and aviators is contained in the General Business Law and the General Municipal Law. The former pertains to aircraft; the latter, to airports.

This digest is not a legal interpretation of the aviation laws of New York State, and it does not include judicial decisions or legal citations to judicial interpretations. It is merely a summary statement of legislation relating to aviators, aircraft, and airports as found in the New York statutes. It is intended as an aid for those desiring to keep informed of the permanent statutes and is not a work of legal reference. *Bureau of Aviation.*

Surplus Property Administration

Aircraft Plants and Facilities. One of a series of reports of the Surplus Property Administration to the Congress concerns "Aircraft Plants and Facilities" dated January 14, 1946. In compliance with instructions contained in Section 19 of the Surplus Property Act, the Surplus Property Administration has submitted a report to Congress on the disposal of aircraft plants and facilities owned by the Government.

The report presents a general picture of all Government-owned aircraft plants constructed or remodeled for the manufacture of air frames, aircraft engines, aircraft accessories, and parts. Primary attention is given only to those plants with buildings and land that cost $5,000,000. It is stated that, unlike some other types of facilities listed in Section 19 of the Act, most aircraft plants are not of a highly specialized character, and the majority of aircraft plants will be sold or leased separately from their machinery and equipment.

The report is divided into three principal parts. Part I describes the amount, cost, location of the property, and other information relative to the use of the property. Part II outlines the economic problems involved in the disposal of the property. Part III gives information concerning the progress of disposal, and a policy for the care and handling, disposition, and use of the property consistent with the policy and objectives set forth in the act.

An appendix supplies additional factual data, listing the specific properties and figures concerning them. A chart shows the wartime expansion of the aircraft industry, measured by airframe weight, number of units, and employment, for the period from 1940 to 1946 inclusive. For sale by the Superintendent of Documents, Washington, D.C., $0.15.

Transportation Facilities. A report by the Surplus Property Administration, dated January 4, 1946, deals with the disposal of surplus transport facilities costing the Government not less than $5,000,000. It is divided into two parts, the first describing the general character of the expansion of facilities and giving the reported cost, number, and location of transportation projects having facilities costing over $5,000,000. Part II discusses the problems of disposal and presents a statement of disposal policy under three general categories within which the properties mainly fall: (1) airports, (2) port terminals, and (3) railway facilities.

A large part of the report deals with the matter of surplus airports, containing information and a list of 44 airports now regarded as surplus, having a total estimated cost of $343,331,000. The information includes descriptions of the locations and facilities and outlines the policies of the administration and the terms decided upon for the disposal of such properties. An appendix contains a reproduction of Surplus Property Regulation No. 16, which sets forth the policy and procedure for disposal of surplus airports. For sale by the Superintendent of Documents, Washington, D.C., $0.10.

Aircraft and Aircraft Parts. This report deals with the Administration's plans to dispose of surplus aircraft and aircraft parts. It is divided into the following parts: Part I describes the Government investment in surplus aircraft and aircraft parts, supplying the reported cost and the number and location of different classes of the surplus. Part II presents a brief statement of the importance of aviation for national defense and the maintenance of high levels of employment. This provides a background for outlining the problems created by, and the program for, the disposition of surplus.

The remaining parts include the specific problems involved in, and submit a program for, the disposition of the different classes of the surplus. Part III deals with tactical planes; Part IV, with transport planes; Part V, with personal planes; and Part VI, with aircraft components and parts. For sale by Superintendent of Documents, Washington, D.C., $0.10.

War Production Board

The Production Picture. Text and charts concerning past and projected production of munitions and the materials used therein, compare such production during the war period with prewar years and, in some cases, make estimates for 1946.

A chart of the major categories of munitions shows that aircraft led all other classes for the month of March, 1945, exceeding $1,200,000,000 in value, and for the fourth quarter of 1945 the scheduled production was 68.2 per cent of the March rate. Other charts and statistics include the production of aluminum, copper and copper-base alloys, steels, textiles, and lumber. *Bulletin 2-47321*, August, 1945.

British Information Services

The Vibration of an Aircraft with Specific Reference to the Wings. J. Morris and I. T. Minhinnick. This report gives a theoretical method for calculating the natural frequencies and modes of vibration of an aircraft in which wing movement predominates, particularly for cases in which one or more engines are carried by each wing. The solution obtained is applied to a four-engined aircraft and the numerical results are given. Various artifices have been introduced to shorten the labor involved and to reduce the method to a routine.

The resulting process, which is self-checking, appears to provide a valuable alternative to full-scale resonance tests. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1928*, British Information Services, New York, $2.10.

British Ministry of Labour and National Service

Finishing Fine Bores. To illustrate the methods followed by a firm in the North Midland region of England for machining the bores of components for the hydraulic equipment in aircraft, two examples are described in detail. The first is a selector valve body made from an aluminum-alloy forging, in which three holes are produced with a diameter of 0.55 in., with a tolerance of 0.001–0.002 in., and 4.5 in. long. The holes are given a honed finish to take the plunger valves. The various operations of drilling, reaming, boring, and honing are described fully, with information concerning the machines and tools used.

The other example is the 3.75-in. diameter bore of the hydraulic cylinder for the undercarriage leg of a famous fighter-bomber produced in the plant. This component is machined from a tough steel forging treated to a tensile strength of 66 tons. The bore is 31.25 in. long and is given a mirror finish, free from any blemish. It is required that the hole must be within 0.002 in. for size, ovality, and alignment over a length of 20 in. A lengthy description is given of the drilling, boring, reaming, and honing operations. *Production and Engineering Bulletin*, December, 1945.

NOW
A New WITTEK Hose Clamp
For Personal Planes

TYPE FBP

TYPE FBSS

TYPE WWD

The great fund of aviation production knowledge developed during the war by aircraft parts manufacturers is now being turned to peacetime planes, commercial and personal. Wittek now offers manufacturers of these planes the FBP Hose Clamp.

The new Wittek FBP Hose Clamp, made from stainless steel and having a band ½" wide, follows the basic FB design, incorporating lighter construction and economy—yet retaining the high Wittek standards for dependability, high grade materials and good workmanship.

In addition to the FBP, FBSS and WWD, Wittek manufactures a complete line of Hose Clamps of various designs. There is a Wittek Hose Clamp to meet every aircraft application. Write for full particulars.

WITTEK
MANUFACTURING CO.
4305-15 W. 24th Place, Chicago 23, Ill.

Aviation HOSE CLAMPS

USAIG
UNITED STATES AIRCRAFT INSURANCE GROUP

America's
Strongest Source of
Aviation Insurance

★

THE U. S. GROUP

★

Comprising 62 Leading
American Owned
Stock Companies

UNITED STATES AVIATION UNDERWRITERS
INCORPORATED
80 JOHN STREET
NEW YORK, N. Y
ATLANTA
CHICAGO
LOS ANGELES

3 NEW INDUSTRIAL PRESSURE SWITCHES

for control of liquids or gases that will not corrode brass

M-500
M-600
M-700

These switches are suitable for control of compressors, water pumps, carbonated beverage machines and any industrial control problem for liquids or gases, and may be used either as a pressure or vacuum switch.

M-500 has an externally adjustable range, fixed differential and a rating of 10 amps, 110v a-c. normally closed, normally open or double throw. Weight 8 oz. Pressure connection ⅛" N.P.T. nipple.

M-600 differs from M-500 only in that it may be manually reset externally.

M-700 carries the same rating as the preceding two with the added advantage of an adjustable differential. This switch however is only available with normally open contacts.

Write for complete specification.

AEROTEC · CO. 61 WESTCHESTER AVE. WHITE PLAINS, N. Y.

ENGINEERS WANTED

AERODYNAMICISTS
Layout Draftsmen
Stress Analysts
with Aircraft Experience

To work in Engineering Dept. of Established Aircraft Company in New York Vicinity—Send resume to

Box 327, Suite 617,
1457 Broadway,
New York City

The Civil Air War

C. G. Grey

Contents: The Needless Dangers of Flying; First Step Towards Safety; The Fire Risk; The Collision Danger; The Radiaura; Ice and Height; Who Will Travel by Air?; Speed in Air Travel; Tourist Traffic; Air Freighting; Science and Education; The Neglected Airships; Early European Airships; Airships in the U.S.A.; German Airships Between Wars; The Case for the Commercial Airship; What Is a Nation?; The Expanding Community; The Expanding Good Neighbour; Appeasement; The Chicago Conference; The Russian Problem; War-time Air Transport; The Open Air; Competition; And So What?; The Troubles of British Air Lines; The Steamship Interests; About Flying Boats; The Aerodrome War; The White Flag Paper; What We Can Do When We Try; A Problem and a Programme.

When a new book by the former editor of *The Aeroplane* is published, it is to be expected that it will be amusing, provocative, and informative. Mr. Grey's new book qualifies on all these counts. His stories are always apropos and add to the readability of his writings. His challenging comments on air safety, American aircraft, and air transport in general are up to his usual standard of critical analysis.

Unfortunately, the book reflects a lack of personal experience in modern air-transport operations, particularly pertaining to the United States. The thesis of the book is that English air transport, when it wins the civil air war now in progress, will lead the world. Similar claims for all forms of British aviation endeavor are made repeatedly by the author.

For those who enjoy having their opinions disputed and their ideas disparaged, this study of the present conflicting status of world air transport will be a stimulus to further discussion. The Harborough Publishing Company Ltd., Leicester, England, 1945; 212 pages, 12*s.* 6*d.*

Why Has America No Rigid Airships?

P. W. Litchfield and Hugh Allen

Contents: Crossing the Atlantic; Safety of Airships; Airplanes and Airships; The Comfort of Airships; The Importance of Helium; Economy of Airships; Basic Strength of the Airship; Advances Due to Research; Airships and the Weather; Graf Zeppelin and Hindenburg; Airship Facilities Available; The 10,000,000 cu.ft. Liner; Why Government Aid Needed; Naval Use of Airships.

The proponents of lighter-than-air craft have always been forceful in presenting claims for their branch of air transport. All the favorable arguments are presented here in a barrage of facts to show that the United States is in the best position to build and operate large airships.

The authors have had long experience with airships of all sizes and they marshal their facts with logic and convincing details. The fundamental evidence that will be weighed in making the decision as to whether or not to continue to experiment in that field is compressed into a small volume. The Corday & Gross Company, Cleveland, 1945; 143 pages, $1.50.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N. Y.

Production Illustration

John Treacy

Contents: Drafting Standards and Practices; Shading Techniques; Reproduction Aids; Reproduction Methods for Distribution; Photographic Illustrations; Linear Perspective; Freehand Drawing; General Uses of Illustrations; The Introduction of Production Illustration; Organization of an Illustration Department; General Reference Illustrations; Perspective Engineering Drawings; Manufacturing Illustrations; Miscellaneous Applications; The Perspective Drawing Board; Function Illustration; Prepared Shading Mediums and Symbols; Instruction in Production Illustration.

Compiled as a guide to the preparation of the perspective illustrations that have been so widely adopted by leading industries, including the aircraft industry, the text gives instructions for the application of perspective to engineering and industrial production. The author was formerly production illustration engineer of Douglas Aircraft Company, Inc.

The illustrations selected for examples are actual production drawings. The preparation of production illustrations, and their practical applications to problems of industrial production, are explained in nontechnical language. Supplementary material is included in an appendix. John Wiley & Sons, Inc., New York, 1945; 202 pages, $4.00.

Book Notes

Practical Aircraft Rigging, by P. W. Blandford; Hutchinson's Scientific & Technical Publications, London, 1945; 80 pages, 2*s.* 6*d.*

Outlining the various aspects of aircraft rigging, a pocket-sized booklet is intended primarily as an aid to students preparing for a civil ground engineer's license or to become a Royal Air Force Flight Mechanic or Fitter. The information is imparted in eleven chapters under headings of Aircraft Parts, Riggers' Equipment; Rigging Details; Rigging Planes; Flying Controls; Ropes and Cables; Fastenings; Hydraulics and Pneumatics; Plastics; Inspection; Repairs; Parking.

Guide to Model Aircraft, edited by David C. Cooke; Robert M. McBride & Company, New York, 1945; 287 pages, $3.00.

A guidebook is offered for those who are interested in building and flying model airplanes for relaxation and sport purposes. It contains material for the modeler who wishes to improve his workmanship, learn short cuts to better construction, and ascertain the answers to puzzling questions. Diagrams and instructions for building many types of model planes are included.

A.S.M. Review of Metal Literature, Vol. I, by Thelma Reinberg; American Society for Metals, Cleveland, 1945; 699 pages, $15.

A bibliography of the current material that has been published on metallurgy. It contains the material listed in *The Metals Review* from February, 1944, through January, 1945, and represents a survey of the books, articles, papers, etc., that have been published during the period January through December, 1944. Brief abstracts indicate the scope and content of each article.

Elements of Aeroplane Hydraulics, by Harold P. Lees; Hutchinson's Scientific & Technical Publications, London, 1945; 95 pages, 2*s.* 6*d.*

Elementary principles of hydraulics applicable to aircraft are outlined. Illustrated by numerous line drawings, explanations are given of the functioning of various hydraulic components of the airplane and instructions are supplied for the maintenance of those components. Two hundred questions and answers test the reader's assimilation of the text.

Machine-Tool Work, by William P. Turner and Halsey F. Owen; McGraw-Hill Book Company, Inc., New York, 1945; 364 pages, $3.00.

A second edition is presented of a book on fundamental problems that are common to all kinds of machine work. New chapters on shop safety and broaching have been added. Material on measurement, which was distributed through the first edition, has been grouped in a special chapter. Problems have been placed in a section at the back of the book.

Inside the Vacuum Tube, by John F. Rider; John F. Rider Publisher, Inc., New York, 1945; 407 pages, $4.50.

The author's purpose has been to provide the reader with a thorough understanding of the theory and operation of basic types of vacuum tubes, as a foundation on which to build a more advanced knowledge of tubes in general. The electron theory and electrostatic fields are explained. The operation of diodes, triodes, tetrodes, and pentodes is made clear.

Shop Terms, prepared by the Department of Education, International Business Machines Corporation; Syracuse University Press, Syracuse, N.Y., 1945; 106 pages, $1.00.

A manual of shop phraseology includes terms encountered in manufacturing plants where the usual types of machine tools are operated, and mechanical and electrical devices are assembled. All terms are defined simply and many of them are illustrated. A guide to pronunciation is provided, as are a complete set of tables for the calculation of feeds and speeds in milling and turning operations. A four-place table of trigonometric functions to assist in the solution of shop problems is included.

Over to You, by Roald Dahl; Reynal & Hitchcock, New York, 1946; 182 pages, $2.50.

A series of ten short stories is centered around incidents connected with World War II military fliers and flying. The stories are based on the experiences of the author, a Wing Commander in the Royal Air Force. Some of them have been published previously in various magazines.

Automatic Weapons of the World, by Capt. Melvin M. Johnson, Jr., and Charles T. Haven; William Morrow and Company, New York, 1945; 644 pages, $7.50.

A complete revision of another extensive volume on weapons and ammunition titled *Automatic Arms.* Most of the chapters are entirely new and all the original chapters have been altered, amended, or replaced. The volume is divided into five parts: the first defines the general principles of automatic weapons, the second traces their history and development, and the third advises how to keep them firing. The fourth tells how they may be employed in combat and the fifth deals with miscellaneous considerations.

There are also several appendixes. The first contains a summary of automatic weapons, the second an ammunition table, the third a list of infantry weapons. The fourth contains drawings and ballistics tables of military ammunition, in addition to sectional drawings of arms.

Engineering Alloys, by Norman E. Woldman and Roger J. Metzler; American Society for Metals, Cleveland, 1945; 832 pages, $10.

A reference book on engineering alloys contains data on the chemical composition, physical and mechanical properties, uses, and manufacturers of proprietary alloys. The authors have compiled available data and information about the commercial and technical alloys manufactured in the United States and many foreign countries. While they have not attempted to include alloys conforming to standard specifications as such, examples of common alloys produced to customer's specifications are listed, and the S.A.E. specification alloys as well as a few others of general interest, are included.

Silhouettes in the Sky; W. Walker & Sons, London, 1945; 16 pages, 2*s.* 6*d.*

A small pamphlet sets forth a method of aircraft identification by means of a cardboard calculator, supplied with the book, which is called a Scientific Height Finder. The principle upon which the use of the Height Finder is based is that, with distance and size so related to one another, the distance of an airplane can be quickly found if the size of the airplane and its apparent size at a given distance from the eye are known. In addition to directions for using the calculator, the pamphlet contains drawings, graph-backed silhouettes, and descriptive data for 26 British and American aircraft.

The Great Pacific Victory, by Gilbert Cant; The John Day Company, New York, 1945; 422 pages, $3.50.

The author's third book about the participation of the United States Navy in World War II completes the history of the war against Japan and the Allied amphibious operations that made victory possible. Beginning with the month of February, 1943, following the Guadalcanal campaign, this volume recounts the sweep toward Japan, the occupation of the Russells, the Solomons battles, the carrier strikes at islands nearer to Japan, the closing of the pincers on Rabaul, Tarawa, the Marianas, Iwo, and Okinawa, the bombings of the Japanese homé islands, and the final surrender. Profiles are given of Admirals Nimitz, Spruance, Mitscher, and Halsey. Numerous maps and battle diagrams illustrate the text.

Collected Papers on Metallurgical Analysis by the Spectrograph, edited by D. M. Smith; British Non-Ferrous Metals Research Association, London, 1945; 162 pages, 21*s.*

A group of papers on metallurgic applications of the spectrograph, most of which were selected from those submitted to the British Non-Ferrous Research Association Spectrographic Panels and subsequently released to members of the Association as research reports. Included in the collection is a contribution from the British Aluminium Company, Ltd., which is more comprehensive in its scope than the others and consists of reports on photographic and other aspects of the spectrographic analysis of aluminum and aluminum alloys.

Manual of Electroencephalography for Technicians, by Robert S. Ogilvie; Addison-Wesley Press, Inc., Cambridge, Mass., 1945; 100 pages, $3.50.

Because the electroencephalographic method of examining the brain, now used by neurosurgeons, neurologists, and psychiatrists, is ultratechnical, technicians entering this field require a high degree of specialized training. The author has prepared a manual to aid technicians who are taking up this line of work. He describes how to set up an electroencephalography laboratory, the way to apply electrodes, how to obtain tracings, and the interpretation of electroencephalograms.

Air Transportation Today and Tomorrow; Air Transport Association of America, Washington, D.C., 1945; 31 pages.

A booklet on the present and future role of air transportation, compiled from statistics and reports obtained from Government agencies, air lines, and other sources. It contains informative data and charts about coast-to-coast air transport, transport planes, airways and airports, and air-line services.

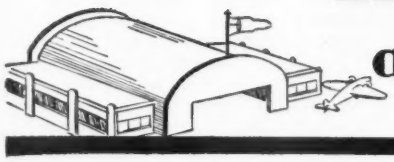
Symposium on Magnetic Particle Testing; American Society for Testing Materials, Philadelphia, 1945; 122 pages, $1.25.

The booklet contains eight papers that were presented at Philadelphia, January 22, 1945, as a symposium on magnetic-particle testing sponsored by the Philadelphian District of the American Society for Testing Materials. The discussions which followed the reading of the papers are included.

How Planes Are Made, by Dickey Meyer; Harper & Brothers, New York, 1945; 63 pages, $1.00.

One of the "Young America's Aviation Library" series explains in simple narrative style, comprehensible to children, how an airplane is designed and manufactured. The step-by-step production of an airplane is traced from the original conception to the completed, tested airplane.

House Organs and Catalogues



War Role of Rubber

Look What It Did to Germany . . . Remember What It Did to Japan. Max Cook. Another in a series of booklets by the Aviation Editor and Chief of Editorial Promotion of the Scripps-Howard newspapers tells of the services performed by rubber in helping to win the war.

Noting that there are approximately 11,000 rubber parts in a single B-29 Superfortress and corresponding quantities of rubber in other airplanes, the writer mentions the great quantities of rubber used in other war equipment and describes the facilities and services of a manufacturer of rubber products. In addition to listing materials in which rubber and synthetic rubber are used, it is shown that textiles and other products of the same company also played a prominent part in the war operations. *United States Rubber Company.*

Aircraft Sales and Service Facilities

In Seven States a Service Institution for the Private Flyer. A brochure of 30 pages describes and illustrates the sales and service facilities available for private aircraft in an area embracing the states of Ohio, Indiana, Illinois, Iowa, Missouri, Nebraska, and Kansas. The facilities of the five airports serving that territory are outlined, with illustrations of the exteriors and interiors of the buildings and with details concerning the commodities and services available and the equipment employed. The remaining pages give information concerning the Ercoupe personal airplane for which the organization is distributor. *Parks Aircraft Sales and Services, Inc.*

Aircraft Tubing

Seamless Steel Tubing for Aircraft Built to Exacting Specifications. The functions of metal tubing in the construction of aircraft are outlined briefly. It is stated that metal tubing was used in the construction of the Langley craft in 1896 and has been employed ever since in one form or another. Aircraft tubing is classified into three general groups: the first is used for such structural parts as the fuselage, engine mounts, gun mounts, control surfaces, and wing braces. The second class is aircraft mechanical tubing, suitable for highly stressed parts such as axles, shock absorbers, landing-gear mechanism, engine parts, and similar applications. The third group is designated as aircraft stainless tubing, used in fuel-injection lines, for hydraulic systems, and elsewhere. The processes of manufacturing and testing such tubing are described and the specifications under which it is made are included. *Michigan Seamless Tube-Tips,* January, 1946.

Radio for Private Planes

G.E. Personal Plane Radio. A 4-page leaflet describes the General Electric AS-1B personal-plane radio and explains the features of the equipment, listing the technical specifications. The unit is offered as a complete twelve-tube radio transmitter and receiver, providing two-way communication with tower and radio-range stations, as well as reception of broadcast stations and radio-range navigational signals. *Publication No. EBA-2, General Electric Company.*

Corrosion-Resistant Coatings

Heresite Plastic Coatings, Synthetic Resins, Molding Compounds. A 42-page illustrated book explains the composition, manufacture, and uses of various grades of plastic coatings designed to provide corrosion resistance for metal products. Although much of the information applies to numerous industrial and household products, it is noted that the material is used for the production of aluminum castings in the water-injection system of aircraft carburetors and in radio and electrical equipment. *Heresite & Chemical Company,* Manitowoc, Wis.

Exploding Shells by Radio

The Proximity Fuze. Hitherto restricted information is presented about the design, manufacture, and use of the proximity fuse, the device developed by the Navy to cause the detonation of high-explosive shells when approaching a target without the necessity for contact or the use of the time element. The construction of the device is explained in nontechnical language and its various parts are illustrated. One of the applications described is the function of the proximity fuse in rockets directed against a radio-controlled target airplane. The contributions of the manufacturer to the development of the device are reviewed. *Cornell-Dubilier Electric Corporation,* South Plainfield, N.J.

Estimate of Air Travel

Air Travel in 1946. Richard P. Cooke. An estimate is made of the expansion of air travel in 1946 as a result of the availability of new types of commercial passenger airplanes and the reconversion of older types. In addition to figures comparing the cost of air travel with other means of transportation, the writer includes the improvements being made in instruments to facilitate commercial aviation and the expansions that are planned in the nation's airport facilities. *Ethyl News,* January, 1946.

Aircraft Construction Material

New Light Construction Material of Great Strength Announced by Martin, U.S. Plywood. A newly developed "honeycomb" construction is credited with making possible an aircraft material consisting of cloth or paper sandwiched between, and firmly bonded to, thin sheets of aluminum, stainless steel, wood veneer, or plastic, making waterproof sheets that are stated to be structurally stronger than other materials of equal weight now available. It is said that the new material is being used in the Martin Model 202 to form the flooring in the cabin and also constitutes one of the principal structural members in the fuselage. The process of manufacturing the material is briefly described, with the statement that it was developed by The Glenn L. Martin Company and the U.S. Plywood Corporation. *The Martin Star,* January, 1946.

Aluminum-Bronze Alloys

Molin Metal is described in a 10-page booklet as a pure aluminum bronze, without iron or other additions, produced in various degrees of hardness to suit the application. The properties of the material, its chemical composition, hardness, strength, and other specifications are supplied in text and tables.

Various applications of the metal are suggested and illustrated in the form of castings and forgings, including aircraft forgings and valve-seat inserts for aircraft engines. *American Art Alloys, Inc.,* Kokomo, Ind.

Welded Fabrication

Tailoring in Metal is the title of a manual on welded fabrication for engineers and designers prepared by Paul H. Setzler. The text and tables give information concerning the factors involved in the choice of welded fabrication and the techniques of welded design. Various types of welds are explained, as well as their effect upon static and fatigue weld values. Devices

that can be employed to reduce cost and improve construction methods are described. *The United Welding Company*, Middletown, Ohio.

War Services of Commercial Aircraft

Clippers at War is a documentary motion-picture film relating the world-wide war service of Pan American World Airways. The picture reviews 15,000 ocean crossings made by the company's airplanes in the nation's service, the transportation of wartime world leaders on 700 secret missions, the building of more than 50 air bases, and the maintaining of an 11,500-mile supply line from Africa through the Orient. *Pan American World Airways.*

Plastic-Mold Lubricants

Dow Corning Mold Release Fluid and Compound is the title of an 8-page leaflet that gives the properties and uses of silicon products named Dow Corning Mold Release Fluid and DC7 Compound. These mold-release agents serve as lubricants to reduce the friction between dies and plastic material, to improve plastic flow, to reduce surface striation, and to afford easy release from the mold or from rubber bags used in low-pressure laminating. The booklet outlines the uses of the materials and explains their properties. *Dow Corning Corporation*, Midland, Mich.

Production of Radar

Radar—A Production Triumph. A brief report on the contributions of the Bell System and particularly of the Western Electric Company tells a part of the story of the development and production of radar equipment. The expansion of the company's facilities is recounted, as well as the system of subcontracting that was organized by which other manufacturers were enlisted to help in the design and manufacture of radar devices for land, sea, and air installation. In addition to designing and manufacturing the equipment, it was necessary to establish training schools to instruct the personnel required for radar operation and for testing and maintaining the equipment. *Western Electric Oscillator*, December, 1945.

Canadian Airport Study

Airports for Tomorrow. A summary is made of surveys conducted during the past 3 years by officials of Trans-Canada Air Lines concerning the construction of airports. Their conclusions are that past and present airport-building design in Canada has been outdated by the rapid growth of aviation and the requirements of larger aircraft. Suggestions are made for the design of a major Canadian airport embracing the results of the study and making provisions for air transport of the present and the visible future. The key to this functional distinction lies in the adoption of a system of decentralized dock units built around, and connected with, a general public building. The idea is similar to that of a modern steamship terminal with its various docks, instead of the centralized railway station. Each of the proposed dock units would be equipped with aircraft berths on a paved loading area and each would lend itself to vertical and horizontal expansion. The main public building would provide space for administration, government, and private offices, concessions, public health, and service areas. The recommendations also call for a proper relationship of terminal area to runway pattern so as to reduce taxiing distance to a minimum; for a location that would permit full development of access roads; and for the possible inclusion of nearby flight strips for the handling of aircraft under conditions of severe weather. The hangars and shops would be situated elsewhere on the property at a convenient distance. *Between Ourselves*, December, 1945.

Promoting Air Cargo

Up by Their Bootstraps. The business-promotion methods adopted by various air lines for the development of air-cargo volume are reviewed for the period between 1925 and the present. It is shown that transport operators have increased their express and cargo loads 17 times; their revenue passenger-miles, 35 times; and the number of passengers carried, 920 times. It is stated that in 20 years the air lines have reached the point of stabilized business that required a half century in the case of the railroads. Instances are recounted of the unusual promotion methods adopted by various air lines to call attention to their services, and, on the more serious side, it is recalled that the air lines rendered extraordinary public service by transporting supplies and relief workers to regions suffering from natural disasters such as hurricanes and floods. *Trade Winds*, December, 1945.

Antenna Masts

Compregnated Wood Antenna Masts for Aircraft. H. C. Green and H. Van Steenwyk. The design and manufacture of antenna masts made of Compreg and brass are described, with particular reference to masts for high-speed aircraft. The mast is stated to consist functionally of a brass antenna rod streamlined and supported by Compreg compressed wood, molded and cured around the rod. The six main steps involved in the process of manufacture of the mast are reported, with particulars regarding the use of Amberlite PR-50 phenolic resin as the impregnating agent and Amberlite PR-14 as the hot-press adhesive. The tests to which the completed mast was subjected are reviewed. *Resinous Reporter*, December, 1945.

ENGINEERS

Work in California!

NORTH AMERICAN AVIATION

Is designing aircraft of the future and needs experienced:

ENGINEERING DESIGNERS & DRAFTSMEN

AERODYNAMICISTS

STRESS ANALYSTS

Biggest research and development projects in company's history offer good pay, fascinating work and opportunity for the future.

Write E. R. Carter
Engineering Dept.
5601 Imperial Highway
Inglewood, Calif.

NORTH AMERICAN AVIATION, INC.

Sets the Pace

Aircraft Engineering

FOUNDED 1929

The Technical and Scientific Aeronautical Monthly

Edited by
Lt.-Col. W. Lockwood Marsh
F.I.Ae.S., M.S.A.E., F.R.Ae.S.

Single Copies: 50 cents post free
Subscription: $5.25 per annum, post free

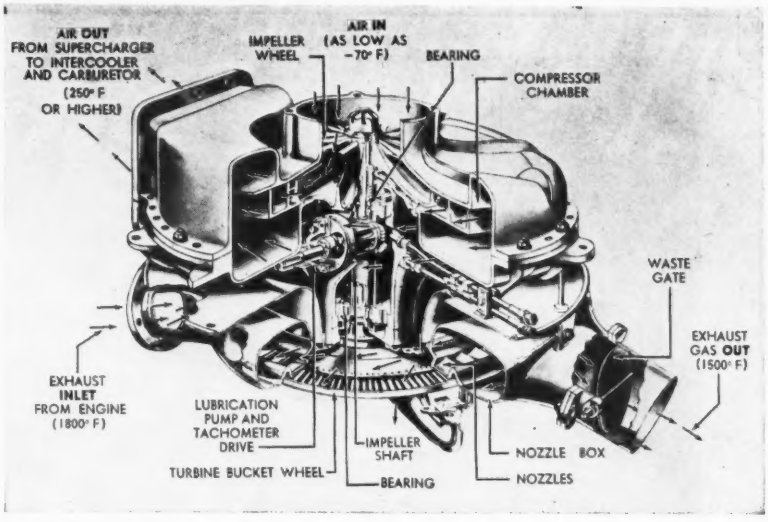
A special feature is made of reproductions and translations from the Foreign Technical Press

BUNHILL PUBLICATIONS LIMITED
12 Bloomsbury Square
London : : W.C.1.
England

Lubrication Manual

Aircraft Lubrication is a 96-page manual in which the technical phases of the lubrication of aircraft are explained in such a way as to be comprehended by pilots of light planes, as well as by the trained pilots and skilled mechanics who handle large transports and cargo aircraft. The writers have devoted the first part of the text to descriptions of the equipment of an airplane, what it does, and how it operates, so that the reader may have an understanding of the mechanics of aircraft in order to appreciate the necessity for correct lubrication. Explanations are made of the individual parts of the airplane requiring lubrication, the method of application, the functions that lubricants must perform, the characteristics of oil and greases, the sources from which lubricants are obtained, and the benefits derived from using high-grade lubricating materials.

The manual is divided into five principal parts, Part I referring to the aircraft power plant and its accessories. Part II deals with the aircraft and the lubrication of its equipment, and Part III discusses aircraft lubricants and their manufacture. Part IV includes operating notes concerning aircraft engines, hydraulic systems, and aircraft equipment. Part V outlines the benefits of correct lubrication and contains a glossary of aeronautical terms. *Socony-Vacuum Oil Company.*



An illustration from Socony-Vacuum Oil Company's 96-page manual about the technical phases of the lubrication of aircraft. In the turbosupercharger, which is shown, the extremely high temperature at the turbine end and the low temperature at the propeller end make the lubrication of this unit difficult.

Alloys and Specialties

Aluminum Bronze and Copper Base Alloys. Bulletin No. 72 contains data concerning the physical properties of aluminum-bronze alloys and copper-base alloys and the uses for those metals. Suggestions are made concerning the services of the manufacturer available for those industries requiring such materials and specialties. *Ampco Metal, Inc.*, Milwaukee.

Return to Civilian Duty

Doolittle Returns to Shell. Incidents in the career of Lt. Gen. James H. Doolittle are recounted in connection with an article in which announcement is made of his return to an executive position with the Shell Oil Company. The article reviews his activities in the first World War and during the period between that war and the second conflict, a large part of which time was given to the service of the Shell organization, as Manager of the company's Aviation Department. General Doolittle's services as the Commanding General of the Eighth Air Force are outlined briefly, together with the story of some of his personal achievements and the honors bestowed upon him. *Shell News*, January, 1946.

Industrial Applications of Plastics

Vinylite Plastics—Elastomeric Compounds shows how plastic compounds of that type have contributed to the improvement of established applications and made new ones possible. It discusses molding and extrusion compounds, flexible sheeting and film, and cloth coating compounds. The properties that have made these plastics useful as engineering materials are described. Illustrations show the applications for which the material is being used. *Bakelite Corporation, Unit of Carbide and Carbon Corporation.*

Electric Motors and Generators

Elinco Type "FB" Motors and Generators. Typical electric motor and generator units are described in detail in a two-color booklet, showing units of this type designed to allow both base- and frame-mounting. Permanent-magnet a.c. and d.c. generators, split-field d.c. motors, permanent-magnet d.c. motors, series and universal motors, and shunt-wound d.c. motors are pictured and described. The construction and characteristics of the various types are outlined, and performance curves are shown for selected units. Drawings give standard dimensions and cutaway views. The manufacturer's facilities for special design work are noted. *Electric Indicator Company*, Stamford, Conn.

Chemistry in Aircraft Maintenance

Plane Portraits contains reprints of articles and illustrations that have appeared in the magazine *Air Tech*, outlining the functions of chemistry in aircraft maintenance. Colored pictures of various types of bombers, fighters, transports, and trainers used during the war are followed by articles on corrosion, engine overhaul, and coatings. *Turco Products, Inc.*, Los Angeles.

Informative Annual Report

Power in Motion. The annual report of the Menasco Manufacturing Company for the year ending June 30, 1945, has been expanded to include information in the form of text, pictures, and charts to make a presentation of the activities of the company during the period. In addition to the usual tabulated statements of earnings and financial condition as of June 30, 1945, and lists of the officers and directors, figures and graphs show the growth of sales volume and the proportions of the total income allotted to wages, materials and expenses, reconversion and taxes, net profits, net assets, plant expansion, and personnel statistics. Brief sketches outline the backgrounds and present duties of the executives of the company. *Menasco Manufacturing Company*, Burbank, Calif.

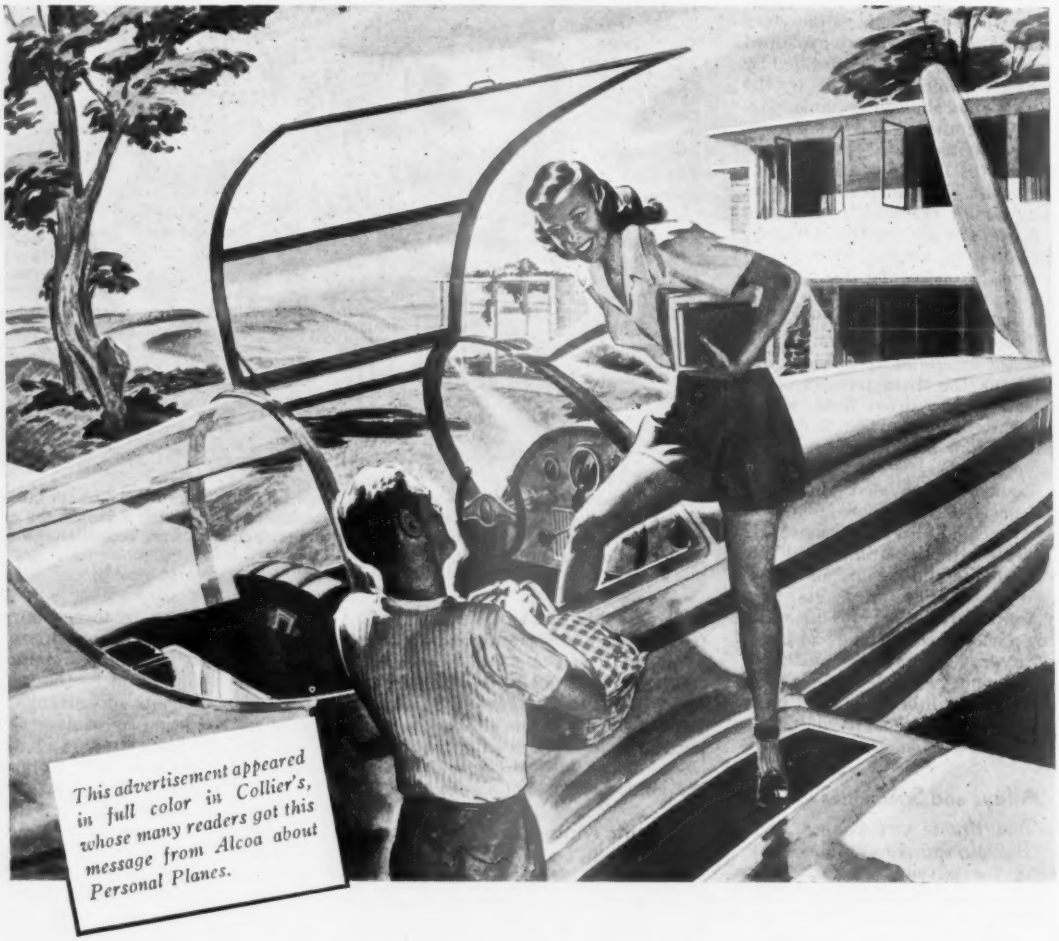
Power-Control Equipment

Precision Power Control. The products and services of a manufacturer of power-control equipment are described and illustrated in a pamphlet. It features the manufacturer's hydraulic dual power package, landing-gear struts and actuators, hydraulic lines, shock struts, flap-actuating cylinders, and similar equipment. It explains the manufacturer's engineering processes, control of materials, workmanship, and testing and inspection standards. *Adel Precision Products Corporation*, Burbank, Calif.

Electrical Review for 1945

Electrical and Allied Developments of 1945. The January issue of the *General Electric Review* presents an annual review of developments during the year in the electrical and allied industries. Sections of the magazine recount the progress made in the various major divisions of industry in which electrical power and control equipment have taken important parts.

The section on transportation outlines the year's activities in aviation with reference to the company's con-


This advertisement appeared in full color in Collier's, whose many readers got this message from Alcoa about Personal Planes.

Your surrey with a hinge on top

Grandpa had a horse. Father, a horseless carriage. Today—and tomorrow—*you* will have wings.

What kind of plane will you want to own? An all-metal, aluminum plane, positively—because the toughest of experience, in peace and war, has proved that aluminum planes have greater built-in safety, lower upkeep cost. They give you more hours of fun in the air with less trouble on the ground. They assure you of greater resale value.

Whatever make you buy, be sure to ask the salesman, "Is this plane built of Alcoa Aluminum?"

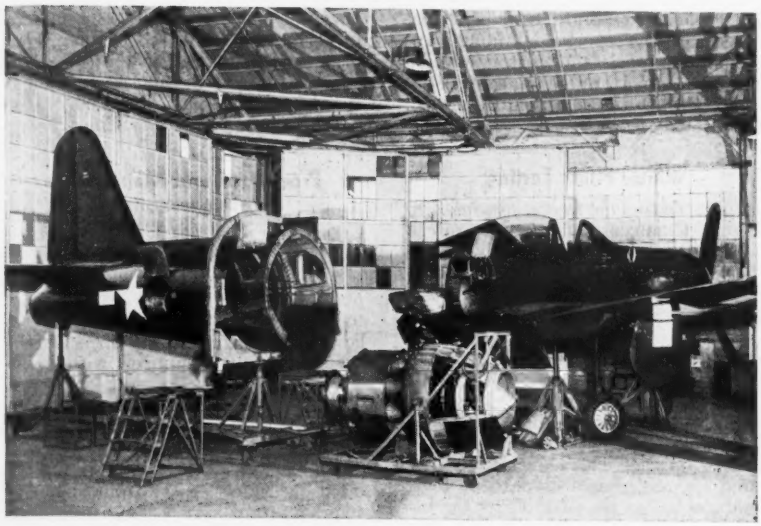
You see, the aircraft industry and Alcoa grew up together. Ever since that historic flight at Kitty Hawk, N.C., Alcoa engineers have worked hand-in-glove with the men of aviation.

As new designs in all-metal planes were developed, new Alcoa Aluminum alloys were developed to keep pace with them—aluminum alloys that had behind them more years of experience than could be found anywhere else.

When you buy that personal plane remember, if it's all-metal, it's safer. If it's Alcoa Aluminum, it's best!

ALUMINUM COMPANY OF AMERICA, 2142 Gulf Bldg., Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN ALUMINUM



The jet engine of the Ryan Fireball after it has been taken from the fuselage. Both engines of the plane are self-contained "eggs." The tricycle landing gear makes it possible to install fuel system and hydraulic equipment accessories in the front wheel well, where they are more accessible to ground crews, without the need for opening access panels.

tributions to jet propulsion, with and without propellers, turbosuperchargers, aircraft armament, aircraft motors and generators, and aircraft instruments and accessories. *General Electric Review*, January, 1946.

Specialized Metals

Westinghouse Metals & Alloys for Communications and Electronic Equipment. Specialized metals and alloys for the communications and electronic industries are explained in a recent 47-page book. Various metals are discussed in each of the five sections. Each material is analyzed with regard to its physical properties, chemical properties, and application, with tabulated figures and charts. A comparison table occupies the two concluding pages, giving the properties of these specialized metals by comparison with other materials.

The five sections deal with magnetic metals and alloys; electrode, filament, and contact metals; cylinder metals; joining materials; and heat-resistant alloys. *Westinghouse Electric Corporation.*

Industrial Plastics

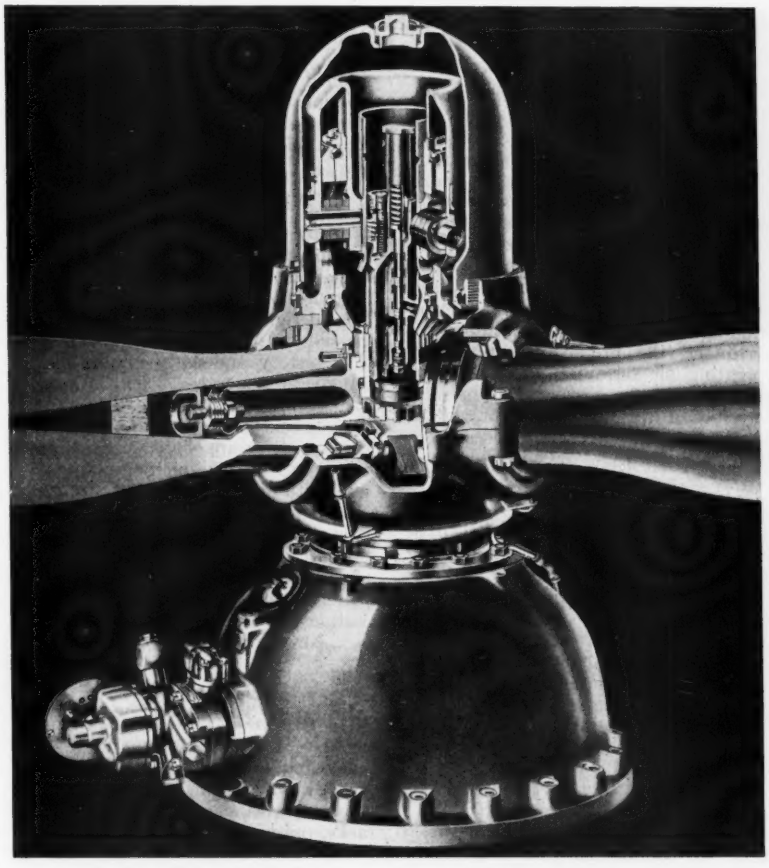
Chemaco Molding Materials. Illustrations and descriptions convey information with regard to the properties, manufacturing processes, and uses of a group of plastic materials. Starting with brief descriptions of the chemical formulas by which the material is manufactured, the booklet outlines suggested applications and typical uses for the manufacturer's cellulose acetate, ethyl cellulose, polystyrene, and vinyl compounds and methods of molding. The physical and chemical properties of the various materials are tabulated. A list of suggested aircraft applications of the materials is included. *Chemaco Corporation*, Berkeley Heights, N.J.

Propeller Evolution

Wherever Man Flies. The development of automatic feathering and constant-speed propellers is presented in a brochure extensively illustrated in color. The booklet describes the early designs of adjustable propellers, with references to the airmen of those days who used them and contributed to their improvement. It traces the successive designs through the years, with pictures of various airplanes on which the propellers were used, as well as drawings showing the interior construction. The present hydromatic propeller is described, and figures are given with reference to the number of propellers that were manufactured for use during the war, as well as the war and transport aircraft that are currently equipped with propellers of that type. *Hamilton Standard Propellers Division, United Aircraft Corporation.*

Varied Services of a Light Plane

F-24: Winged Worker of Many Skills. Varied services performed by the Fairchild F-24 personal airplane demonstrate the versatility of the plane and its adaptability for commercial and industrial uses, as well as for personal transportation. Among the enterprises in which the plane renders service to business are mining companies, sheep raisers, chain stores, "dude ranches," oil and gas pipeline companies, wildlife and forest-protection units, soil-conservation workers, charter operators, and others. The article recounts numerous instances of



A cutaway view of the Hamilton Standard hydromatic propeller.

the satisfactory performance of the plane in such work. *The Pegasus*, February, 1946.

Air-Borne Radar Equipment

Radar on Wings. Descriptions are given in nontechnical language of the radar equipment used for airplanes and lighter-than-air craft and the services performed by such equipment during the war. The work of one manufacturer of such equipment is reviewed, and several types of air-borne radar devices and of the services they performed are described. *Philco Corporation*, Philadelphia.

Petroleum Products for Aviation

Characteristics and Tests of Esso Aviation Products is published for the information of air-line operators and the builders of aircraft and engines. The first section of the booklet deals with the nature, production, and refining of petroleum, and the relationship of the various refining processes to the finished product. The second section refers to the properties and uses of the finished products, explaining the grades, characteristics, and ratings of aircraft fuels, lubricants, and greases. A reproduction is included of an aircraft-lubrication chart, giving a detailed diagram of the application of lubricants and greases to an airplane, and tables of technical inspection data for aircraft oils and greases. *Standard Oil Company of New Jersey.*

Review of Air Power

Bulletin of the Air Power League. The December, 1945, issue of the *Bulletin of the Air Power League* contains a general survey of the present position of commercial and military air transport. The first article tells of the development of air commerce based on the experience gained during the war in air transportation of goods and personnel. Succeeding articles refer briefly to the new techniques in maintenance, the training of commercial and military air personnel, the problems involved in operating air terminals, new military aircraft, and the history and present activities of the Civil Air Patrol. *Bulletin of the Air Power League*, December, 1945.

Air-Line Report

The Northwest Passage is the title of a brochure incorporating the annual report to the stockholders of an air line, which has been expanded into an extensive review of the company's history and operations. It relates the progress made in the establishment of new civilian air-transport routes and plans for future route extensions; reviews the war activities of the company, including the work performed at a modification center established for the A.A.F.; reveals the extent of the research work performed for the Government; and gives a broad outline of the future prospects in commercial air transport. The booklet contains the usual financial reports for the fiscal year ended June 30, 1945. A separate booklet is enclosed with the report, containing maps and photographs of the territory covered by the company and giving statistics with regard to the communities served. *Northwest Airlines, Inc.*

Winter Flight Testing

Flight Testing the Packet for Sub-Zero Safety. Changes made in the winterization equipment of two Fairchild C-83 Packet airplanes are described in connection with a report on the flight testing of those planes under extreme winter conditions in Alaska. The tests were conducted by the Cold Weather Detachment of the Proving Ground Command and the Climatic Requirements Office of the Air Technical Service Command, both at Ladd Field, Fairbanks, Alaska. The planes were prepared for recording test data at temperatures as low as −65° F. by the installation of thermocouples on the cylinder heads and certain of the intake pipes, on the carburetor screen, at various points in the oil lines, in the accessory compartment, in the left center section leading edge, in the left nacelle torque-box area, and in the left nacelle wheel well. Direct-cranking starters in place of the standard inertia starters, static-discharge radio equipment, an auxiliary power unit, new control actuators, fuel injectors for cold-weather starting, new Hamilton Standard propellers, extra heat exchangers for the thermal anti-icing apparatus, and special tires for operation in snow and ice were among the other equipment installed for the tests. The work resulted in substantial advances in the techniques of cold-weather operation of aircraft. *The Pegasus*, February, 1946.

Metal Casting Process

Microcast Process. A comprehensible explanation of the Microcast process of precision casting is imparted in an 8-page leaflet. It also defines the industrial design advantages that are made possible through the use of this process. The history and early applications of Microcast are traced briefly. In addition, specifications and the physical and chemical properties of Vitallium Microcastings are offered as examples of one type of high-melting-point alloy used with the process.

Illustrations depict castings of intricate shape and design which have been produced of high-melting-point, nonmachineable alloys. There is also a pictorial step-by-step description of the casting process. *Austenal Laboratories, Inc.*, New York.

Data on Gears

Abart Gears. Containing engineering data in brief copy, a new 4-page illustrated bulletin deals with spur, bevel, worm, helical, and internal gears, worm wheels, spiral, sprockets and racks, precision cut from any gear material. It is stated that there are no stocks of this item, the gears being cut to customers' specifications only. A page of photographs shows several precision-gear cutting, shaping, and inspection operations in the company's plant. Illustrations and a summary of speed reducers are included. *Abart Gear & Machine Company*, Chicago.

Production and Maintenance Suggestions

Douglas Airview, September, 1945. (1) Formula for a positive chlorobromide photographic emulsion for photo templates enables airplane plant to manufacture the emulsion in its own laboratory; (2) a method of reclaiming cable assemblies equipped with defective stops, by reducing radiuses through use of peneumatic squeezer, saves man-hours and material; (3) by using a series of four jigs first to locate correctly the attach angles, pulley brackets are located accurately in the front spar and man-hours are saved; (4) a new type of fixture for wing-flap synchro mechanism eliminates guesswork in rigging flap cables; (5) eliminating old hand-screw type clamps, a new spring-type clamp attached to the jig saves man-hours; (6) a boom jig for aligning the trailing edge bulkhead ribs before joining to mid-rear section saves time; (7) tack-welding an assembly jig for an oil support rather than riveting it effects a saving of time; (8) the use of aluminum in place of bronze or steel for a roll on the Yoder rolls saves both man-hours and material; (9) standard trimming for both nose-wheel doors of a plane saves time; (10) the use of a duplicating punch to aid installation of deicer boots enables punching of holes to be performed faster and more accurately.

Allison News, November 20, 1945. A motor-driven apparatus for feeding major studs through a thread comparator helps regulate the "flow" of studs through the comparator so that marred or imperfect threads or metal build-up on threads are more easily detected by the operator. In addition, the apparatus makes possible automatic ejection of studs containing imperfections.

Fairchild Aircraft Fad, November 2, 1945. (1) A new method of lining up bushings in a jig prevents the bushings from going out of round, reduces setup time, and is applicable to bushings of all sizes up to 2 in.; (2) an idea for use on instrument vacuum lines reduces the time needed for pumping down the lines and can be used on any plane with blind-flying equipment; (3) tool for use in the laying out of castings and welded fittings saves time in the computation of angles.

Republic Aviation News, October 12, 1945. (1) A set of special kirksite dies forms complete corrugation in sheet-metal parts in one operation, saving production time; (2) improved method of testing external and main fuel-tank lines for leaks.

Allison News, November 2, 1945. A solution for stripping plating from defective bearings reduces costs and increases production.

From the Industry

Report of Air-Route Expansion

The network of air routes available for the transportation of passengers, air mail, and cargo in the United States was increased by 4,042 miles in 1945, according to a report on the expansion of air-line routes in 1945. The total number of route miles which the domestic air lines are now authorized to fly has reached 66,979.

The year was also a record-breaker in international operations, with the granting by the Civil Aeronautics Board of certificates for routes across the North Atlantic through Europe to Russia and India to three carriers of the United States. Examiners of the Board made recommendations for service across the South Atlantic and the Pacific which were not finally decided by the full Board, while determination of broad extensions in the Caribbean was still to come.

The international-route miles certificated at the end of the year totaled 106,197 miles for the U.S. carriers. This includes prewar routes (changed in some respects because of short cuts made possible by advances in operations achieved during the war) and the new routes over the North Atlantic to the west coast of Europe and beyond.

The principal segments of the overseas routes were as follows: American Export (now American Overseas Airlines), 9,208; Pan American—transatlantic, 28,718, Latin American, 18,050, Pacific, 18,297, Alaskan, 1,579; Pan American Grace, 9,786; Transcontinental & Western Air, Inc., 20,539. In comparison, the 1940 figures showed a total of 57,804 miles divided as follows: American Export Airlines, 6,817; Pan American Airways, 44,583; Pan American Grace, 6,404.

The new routes added to the domestic air-line system of the United States in 1945 followed the establishment of 8,435 miles of new routes in 1944. The total of 12,477 miles undertaken in these two wartime years substantially exceeds the country's entire system of airways only 17 years ago.

The principal awards of new mileage in 1945 involved seven domestic carriers and occurred prior to September 30, while others related to comparatively minor terminal changes. The largest single new extension was made when Delta Airlines received a certificate to add 1,224 miles to its system. Air Transport Association.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Power-Brake Valve

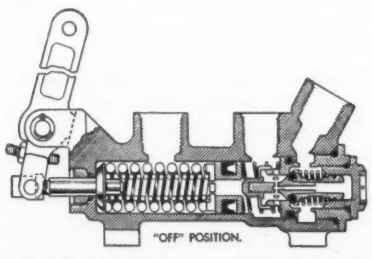
A new hydraulic valve controls the application and release of power brakes on airplanes. This valve provides means for stepping down the pressure from the accumulator pressure to a suitable pressure for operating the landing-gear brakes, as well as controlling brake application in response to the pilot's foot operation of the brake pedal.

No auxiliary pressure-reducing valves or hydraulic deboosters are required with the valve, which is claimed to be "universal" in that it will handle accumulator pressures up to 3,000 lbs. per sq.in., reducing these pressures to any required brake-actuating pressure. Saving in overall weight of the hydraulic system is claimed as one of the advantages of the design.

It is stated that the power-brake valve includes advanced brake engineering, combined with ruggedness to give smooth, positive operation of the brakes. A feature of the design is a large inlet poppet valve which is balanced by differential hydraulic pressures. The valve is held on its seat by light pressure from a small compression spring and a slight hydraulic pressure. As a result, only the slightest touch is needed to unseat the valve and apply hydraulic pressure to actuate the brakes. Because of light seating pressure, a flexible synthetic rubber sealing member can be used for the valve, which provides a seal that is fluid-tight. It is also claimed that the large diameter of the inlet valve insures ample volume of fluid in a minimum period of time to operate the largest brakes used on aircraft.

Other features attributed to the product are immediate indication to the pilot if failure occurs in either the power line or brake line; adjustable external limit stops; needle bearings for the operating lever. Saving of weight is reported to result from the fact that the valve is the only unit required on any system between the accumulator and the brakes.

Operation of the universal power-brake valve is based upon the principle of a balanced piston. The piston is balanced by the action of brake-line fluid pressure on one side and spring action on the other. Bendix Products Division, Bendix Aviation Corporation.



Bendix Universal power-brake valve with working parts in position for brakes released. The inlet valve is closed, preventing high-pressure fluid from reaching the brakes, while the open outlet port relieves pressure in the hydraulic line to the brakes.

Versatile 4-Lb. Personal-Aircraft Receiver

A two-band aircraft radio receiver, weighing only $4^3/_4$ lbs. including power supply and shock mounts, marks the entry of the manufacturer into the personal-plane radio field. The Bendix PAR-70 provides for reception of broadcasts, radio-range signals, control-tower directions, and—when a loop antenna is added—allows aural-null homing as an aid to navigation.

The new receiver and self-contained power supply is $4^5/_{16}$ in. high, $5^3/_{16}$ in. wide, and 7 in. deep, and is designed to fit into the personal-plane instrument panel. Both loudspeaker and headphones may be used.

The frequency range extends from 200 to 400 kc., and from 550 to 1,500 kc. On the 200- to 400-kc. band, the receiver picks up airport control towers, civil-airway stations, and range stations. The other band provides for reception of the regular broadcast programs for entertainment or navigation. Current consumption is 2.5 amp. from a 12-volt battery, or 1.25 amp. at 24 volts. An added feature is a built-in range filter to provide clear voice reception of weather reports and airway control.

Tuning is accomplished through a 4 :1 planetary drive that allows setting the receiver to the desired frequency in flight with a minimum of effort. All cables and external wiring are brought

out through the bottom of the unit so that the depth dimension remains fixed. The unit may be fastened to the instrument panel with or without shock mounting as desired. Attaching of the unit requires only four mounting-screw holes. A decorative rectangular escutcheon plate is available for the receiver in the event a rectangular face is desired rather than the round dial.

A loop switch provides for using the sensitive PMN-1A Bendix loop as a navigational aid. This loop is 11 in. high, 9 in. in diameter, and weighs only 20 oz. It is capable of being rotated by hand and has a 360° azimuth dial for overhead or underfuselage mounting. Bendix Radio Division of Bendix Aviation Corporation.

Miter Gear Boxes

A recently released series of miter gear boxes and brackets is designed for standardization, economy, efficiency, and ease of installation. Strength and resistance to shock are said to characterize the fabricated steel construction. Extra-long hubs provide for generous self-lubricating Oilite bearings and oil reservoir, as well as a convenient place for support of the gear box by the clamp brackets which are designed to allow line-up in one place during installation. Oil-sealed and plain types are offered in shaft sizes ranging from $^1/_2$-in. to $1^1/_2$-in. diameter. Gear dimensions and horsepower ratings are in accordance with standard power-transmission practice. Brooks Equipment Corporation, Hoboken, N.J.

Universal Joints

A newly designed steel universal joint employs a device that provides a positive lock for the pins and a convenient method of disassembly. The heat-treated alloy steel used is precision ground, adding smoothness, long life, and efficiency to the strength and even distribution of wear obtained by employment of a symmetrical design for pins and blocks. For convenient handling the joints are rust-proofed and individually packaged. Brooks Equipment Corporation, Hoboken, N.J.

Flexible Gear Turrets

Called the Flexible Gear Turret, this new flexible design provides means for connecting shafts that form any angle between 0° and 95° on either side. An arrangement of the bevel gears attached to shafts, which are supported in hinged housings, permits the shafts to oscillate and rotate simultaneously. Horsepower capacities are based on the Lewis formula and are consistent with standard power-transmission practice used for shafts ranging in size from $^3/_4$-in. to $1^1/_2$-in. diameter. Two types of brackets are offered for convenient and economical means of supporting the gear boxes. Brooks Equipment Corporation, Hoboken, N.J.

Twin-Valve Pump

A dual-valve pump is stated to be under test by Army, Navy, and commercial air lines. It is reported that toward the end of the war a number of the pumps were in successful use on military planes. The unit is credited with assuring accurate control under all conditions and delivering a constant flow of fuel at almost constant pressure and volume. This is accomplished by the incorporation of two relief valves within the pump mechanism. Working on a common guide pin, the dual valves balance each other and make pressure regulation possible.

The unit is now manufactured in two models with respective capacities of 830 and 1,600 gal. per hour at 2,500 r.p.m. The dual valves insure that the discharge pressure will vary only minutely from the original setting. Candler-Hill Corporation, Detroit.

Machine for Inside-Finishing of Shock-Absorber Housings

Automatic finish sizing and surface conditioning of the inside diameter of steel-tube shock-absorber housings is currently being done by one manufacturer at a rate of 720 tubes per hour on a single machine. The operation consists of pushing hardened steel balls through the tubes to finish them to 1-in. inside diameter. For this purpose the company employs a Colonial "Utility" hydraulic press equipped with automatic indexing fixture. An automatic loading and feed mechanism for the balls also was built into the machine.

The installation operates on a continuous cycle. Even unloading of the work is automatic. The operator merely drops the tubes—two at a time—into the indexing fixture at the loading station. The ram of the press is fitted with a head having four push rods. Two of these are for pushing the balls through the tubes, two tubes at a time, and the other two rods are for ejecting the finished tubes from the fixture.

As the indexing fixture aligns two tubes in front of these chutes, triggers release two balls which roll into position on top of the open-end tubes. In the next machine station, the balls are pushed through. The balls then drop into a lower hopper and are raised into the upper hopper by the hydraulically operated feed mechanism, which is interlocked with the machine cycle. More than two balls are used in the machine, of course, the design of the feed mechanism being such that the raising of two balls positions two other balls in the chutes ready for release by the trigger mechanism.

When finished tubes reach the proper station, the two ejector rods push the tubes down and out of the fixture, the tubes dropping out through an opening in the side of the machine base.

Operation of the machine is hydraulic throughout, including the index and feed mechanisms. The design of the hydraulic mechanism follows the standard design practice as used on Colonial broaching machines. Indexing takes place near the top of the automatic return stroke, just before the ram starts down again. The machine has a rating of 6 tons with an 18-in. adjustable stroke. Colonial Broach Company, Detroit.

Consolidated Vultee XP-81

Termed the A.A.F.'s newest long-range jet fighter, the XP-81 is undergoing tests at the Muroc Army Flight Test Base in California. Its speed is more than 500 m.p.h. Power is provided by a General Electric gas-turbine engine driving a propeller, and a separate jet engine. The combination power units are reported to be able to produce virtually as much power as all four engines on a B-29 Superfortress.

The XP-81 is an all-metal, low-wing, land monoplane, equipped with a tricycle landing gear. Its length is 44 ft. 8 in., its wing span is 50 ft. 6 in., and its height 13 ft. 6 in. Gross weight of the single-seat fighter is 19,500 lbs. Performance data are still secret.

Known as the TG-100, the G-E engine installed in the nose is an axial-flow compressor type, while the I-40 G-E unit in the aft section of the fuselage is a centrifugal jet engine, the same type used in the P-80 Shooting Star. Similar engines are being considered as power units for the Convair 37 204-passenger transport.

In the XP-81, both the propeller and jet engines are used for take-off. For cruising purposes, the front engine is

ENGINEERS WANTED

Mechanical
Electrical
Civil

Preferably those with

Experience Adaptable to AIRCRAFT

Layout Draftsmen
Aerodynamicists
Stress Analysts

Or others with at least several years of engineering experience which will serve as a basis for aircraft work.

Permanent positions are available in the engineering of such planes as the Martin 202 transport, commercial version of the Martin MARS, and other new commercial and military commitments. Write including full information on education, experience and background,

to Director of Engineering Personnel,

The Glenn L. Martin Company

Baltimore 3, Maryland

generally used. However, the plane can fly on both engines or either one. Normally, the rear jet engine is used only when exceptionally high speeds are necessary. Both engines burn kerosene, which obviates the necessity for separate fuel systems. Neither engine requires a warm-up. An appreciable amount of thrust also is obtained from the front engine through the exhaust jet directed under the fuselage near the center of the plane.

The wing is an N.A.C.A. laminar-flow type, with an area of 425 sq.ft. The stressed-skin wing is flush-riveted and rivet heads are milled. Because of the heavy skin, no dimpling occurs during assembly. Thus a smooth aerodynamic surface is achieved without the necessity for painting and other treatment to fill in depressions.

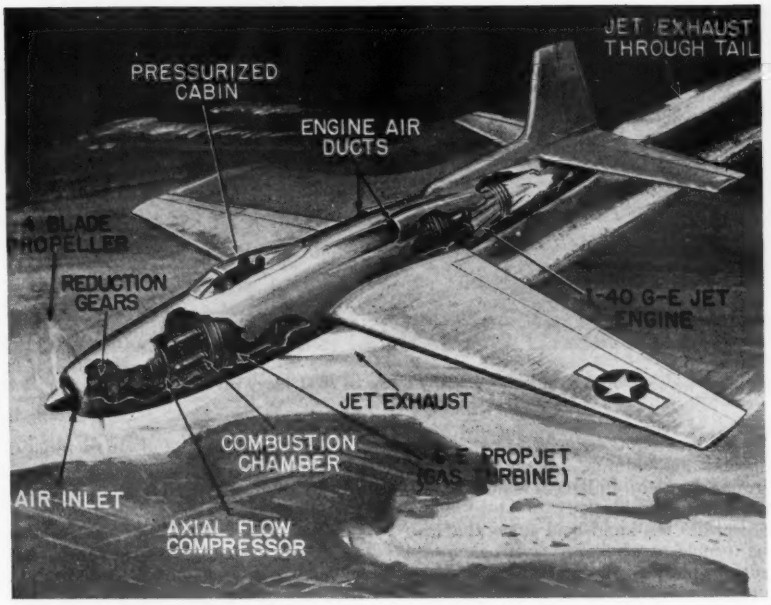
The heavy plating is applied on the forward 34.5 per cent of the wing, and this area comprises the structural torsion box and main spar, extending to the center line of the fuselage. The aft part of the wing is semistructural and provides adequate strength for support of equipment, ailerons, and flaps. Cover plates are designed in the wing to permit quick access to all parts to facilitate inspection and repair.

Thermal anti-icing is used to protect the wing and empennage surfaces from ice. Hot air derived from the pressurized air of the TG-100 engine and heat from the exhaust stack is ducted to the forward sections of the wing and tail surfaces. Space is provided inside the wing to house the main landing gear completely and to install several guns. The tricycle landing gear is actuated by electric motors. An emergency method of operating the gear is provided in case of electrical failure.

Extensive use of 24S-RT, age-hardened aluminum alloy is made in the fuselage, which is of semimonocoque construction. A bubble-type canopy covers the pilot's compartment. The transparent enclosure slides aft and stops are provided for several intermediate positions. A device for catapulting the pilot from the cockpit in an emergency is under development. It will be similar to the apparatus first developed for the XP-54 experimental fighter.

The cabin is pressurized by air from the TG-100 compressor. Refrigeration also is provided to maintain comfortable cockpit conditions regardless of the climate or altitude. An automatic pilot to relieve pilot fatigue during long periods of operation is installed in the plane. Large air scoops are designed in the sides of the fuselage to admit air to the I-40 jet engine. The TG-100 gas-turbine engine obtains air through an annular scoop at the front of the engine. Internal tanks are located just aft of the pilot's compartment. For long-range operation, provision is made under the wing for carrying external tanks that can be dropped when the kerosene used as fuel is consumed.

Performance characteristics of the XP-81 make it adaptable not only as a long-range bomber escort, for which it



Consolidated Vultee's XP-81 is powered by a General Electric gas-turbine engine in the nose and a jet engine in the tail.

was primarily designed, but also as an interceptor fighter. Its heavy fire power makes it an effective weapon against armored columns and tanks, and its ability to carry bombs and rockets makes it useful for attacking strong positions. Consolidated Vultee Aircraft Corporation.

"Packaged" Horsepower for Douglas DC-4's

It is claimed that a 20- to 25-m.p.h. increase in the cruising speed of the airplane, faster and more economical engine maintenance, and a pay-load gain of more than $^1/_2$ ton will result from a new Cyclone power-unit installation for the Douglas DC-4. The power unit was designed as a means of "packaging" higher horsepowers for the DC-4 without modifying the frame of the airplane in any way.

The unit, which is to be produced with the cooperation of the Rohr Aircraft Corporation, consists of the Cyclone 9HD equipped with a prefabricated nacelle that attaches directly to the present DC-4 wing and fire wall.

It is expected that use of the Cyclone power unit in the DC-4 will bring a calculated 8 per cent reduction in direct operating costs. This is equivalent to approximately $20,000 more profit per airplane annually under typical air-line operating conditions.

The first delivery of the packaged power units is scheduled for Chicago and Southern Air Lines for use in a new fleet of DC-4 Skymasters now on order. Negotiations have already begun for the production of substantial quantities of the power units to be used by other air-line operators.

The Cyclone 9HD power plants in the new unit, which develop 1,425 hp. each for take-off, will increase the cruising speed of the plane to approximately 265 m.p.h. at only 60 per cent of power, a gain of nearly 10 per cent. The cruising rate thus becomes almost the same as the former top speed.

The added power, plus the lighter weight per horsepower of the four engines, will allow the plane an increased pay load of from 1,200 to 1,400 lbs.—this being equal to more than six passengers and their baggage, that much air mail or cargo, or enough fuel, augmented by lower gasoline consumption, to increase substantially the cruising range of the plane.

Maintenance problems also will be simplified by the Cyclone 9HD installation. The cowl panel, built in three sections, is held together by special-type fasteners that take only a moment to snap open or shut. By removing four pairs of bolts in the rear cowl panels, the entire accessory section of the Cyclone engine can be exposed for maintenance. Curtiss-Wright Corporation.

Precision Gages Assembled from Small Kit

The "Producto-Chek" gage kit is designed for production checking. It consists of a number of instruments to be used in conjunction with gage blocks for quickly setting up practically any type of inspection gage. A few examples of these are the dial-indicating snap gage, plain bench comparator, dual bench comparator, angle comparator, square comparator, precision height gage, depth gages, and a series of "go-no-go" snap gages of any size up to 18 in. Plug gages and internal gages of any size in steps of 0.0001 in. can be made up quickly from the set. In addition, gages such as hole-to-hole, hole-to-base, parallel-bore gages, pitch diame-

Douglas Aircraft Company's new BT2D-1 Navy dive bomber.

ter, and many others can be made up for special applications. A set of holders from 2 to 18 in. in length is designed to carry the gage blocks.

Besides the hand-held gages that can be formed, a whole series of bench and surface plate gages can be assembled by using the base block, master flat, or numerous other attachments. There are several unusual types of gages. One of these is an indicating snap gage incorporating a dial indicator. Another is an internal gage incorporating a dial indicator. Also, there is an angle comparator using two dial indicators, which is set with a sine bar. When an angle identical to that of the sine bar setup is checked, the dials read alike.

Included in the kit is a multiple bench comparator that makes two measurements simultaneously, permitting increased speed in production checking. Another instrument is an indicating square check gage. With this, the work is placed on a master flat and is simply pushed against a back stop, a dial indicator showing instantly whether or not the angle is 90°. A feature of the kit is a set of "wires" of various diameters. These are lapped to the accuracy of gage blocks and are used direct as plug gages or in caliper jaws where square jaws could not function or where combination square and round caliper jaws are needed. Although it is used in conjunction with gage blocks and in some cases with a surface plate, the kit itself does not include these items. Any one of the gages can be assembled in 5 min. or less, and it takes even less time to dismantle and replace the kit. The complete kit weighs only 40 lbs. and is housed in a hardwood box measuring 10 in. by 20 in. by 4 in. The DoAll Company, Gage Division, Minneapolis.

BT2D-1 Dive Bomber and Torpedo Plane

One of the newest additions to American air power—the Douglas BT2D-1—is now under full production at the company's El Segundo plant where production for the Navy only is carried on.

The BT2D-1 is both dive bomber and torpedo plane, with a range in excess of 1,500 miles, a bomb-torpedo-mine load of 6,000 lbs., and a battery of 5-in. rockets and 20-mm. machine guns in the wings. Reminiscent of the Douglas SBD in appearance and characteristics, the new craft is considered a successor to the Dauntless dive bomber.

Although a heavy-load-carrying bomber type, the BT2D-1 has excellent maneuverability and rate of climb, while in vertical dives from service ceiling it is reported to have reached true speeds in excess of 500 m.p.h.

The BT2D-1 is equipped with fuselage dive brakes. In addition to important aerodynamic advantages, this device affords the equivalent retarding effect of conventional trailing-edge wing flaps, although having less than 80 per cent of the brake area previously required.

The new dive bomber was originally conceived in July, 1944, for carriers of the "Essex" class and has a wing span of slightly more than 50 ft. Subsequent development, however, plus a wing-fold to 24 ft., permit it to operate from any carrier.

The power unit is a single Wright R-3350 radial engine, delivering 2,500 hp. at take-off speed of 2,900 r.p.m. A four-blade Aeroproducts propeller 13½ ft. in diameter is used. The plane is 39 ft. long and weighs 10,470 lbs., minus useful load. Douglas Aircraft Company, Inc.

Contact-Resurfacing Tool

A tool for resurfacing all types of contact points and screws used in magnetos, distributors, and other electrical units consists of two major parts—a holding ring and a revolving resurfacing plate. Old points are rigidly held by a holding screw in their proper holes in the holding ring. The rotating resurfacing plate, equipped with a special abrasive disc, produces a clean, square point that insures good electrical contact.

Each tool is equipped with two feeler gages, two extra abrasive discs, and an electric-drill adapter that replaces the handle when the tool is to be arranged for power operation. Edison-Splitdorf Corporation, West Orange, N.J.

Float-Equipped Grumman Wildcat

In the latter part of 1942 the float-equipped Zero, an innovation in fighter-plane design which proved effective for certain types of operation, and the lack of carrier decks from which to launch suitable air support for our naval operations, led the Navy to modify the Grumman Wildcat by installing Edo seaplane floats to counter the seagoing Zero. The possibility of the loss of Guadalcanal and its fighter bases dictated the need for water-based fighters to operate from island harbors.

The result was a twin-float version of the carrier-based fighter, which passed through Navy rough-water tests, and whose flight performance is described as excellent. The first set of floats was completed and installed by Edo within 90 days after the Navy called on the company to make the installation, and 100 complete sets of floats were produced in record time to prepare this aircraft for possible combat against the Zero. The craft came to be known as the "Wild Catfish."

The design requirements called for the stress analysis and reinforcement of the Wildcat's wings and fuselage to withstand the seaplane loads, and the design and construction of a new set of stabilizer tip fins, in addition to the development of the complete float gear. The speed and success with which it was accomplished was made possible by Edo's prewar commercial float developments and its experience in fitting over 300 different types of planes with floats. Edo Aircraft Corporation.

Instrument System Eliminates Directional Errors

A new General Electric team-like electrical system of instruments is said to give an airplane sustained and pinpoint directional accuracy in flights controlled by autopilots, without the necessity for gyroscope corrections being made by pilots or navigators except for wind-drift deviations. Known as the compass-controlled directional gyroscope, the system also functions to give correct and continuous data on directions when the plane is being manned by a pilot.

One of the major advances in this method of harnessing the compass and gyroscope into a steady computing unit is that errors, which normally would crop out in either of those instruments operating separately, are corrected automatically. For instance, the gyroscope operating by itself drifts slightly from a set course during airplane flight primarily because of the relation of the gyro to the earth's rotation. This means that gyroscopes not teamed electrically with the compass must be reset slightly at intervals by the pilot. The impulses from the compass in the new G-E system do this job, automatically and correctly, for those minute directional drifts of the gyro.

Another factor of minor error in autopilots operating without the system is that the compass vibrates slightly, with the needle flicking back and forth over the true directional line. When those vibrations are balanced, the compass line is accurate. However, an autopilot answering the compass directly tends to edge off the predeter-

mined line of flight of the plane at fractional angles.

The new system of coordinating through an electrical coupling of the compass and gyroscope eliminates both of those errors. The instruments and electrical and magnetic transmitters also are so connected that if the gyro should be knocked out of operation, the pilot can flick a switch and get directional data directly from the compass. Also, should the compass be shot out, the gyroscope will continue its normal functioning.

The compasses in this G-E system are remotely located, usually far out on the wings of the plane, where they are not disturbed by the metallic armor and other units in the cockpit of the military plane. They are connected with an electrical transmitter.

Electrical impulses from the compass transmitter then go to the small and light electric-driven G-E gyroscope. Previously, these compass impulses went directly to instrument dials in the cockpit or other places in the plane without any connection with the directional gyroscope.

The new gyroscope, around which the instrument system is built, embodies several advanced elements. It is stated to be the first instrument of its kind to have universal freedom of motion. Its smooth and accurate operation is not thrown out by sharp dives, spins, rolls, or other combat tactics or acrobatics. It takes up only $3^1/_4$ by $3^1/_4$ in. of space on the panel and weighs less than the one which it will replace. In addition to being lighter, it also has some additional autopilot elements not contained in the old type. General Electric Company.

New-Type Small G-E Electrical Gyroscopes

Advanced types of directional and climb-and-bank electrical gyroscopes are small in weight, as well as in overall size, in comparison with gyros that they will replace. Each of the new-type electrically driven gyroscopes requires only $3^1/_4$ in. diameter of space on an airplane instrument panel. The new directional gyro weighs less than the old by more than 1 lb. The new bank-and-climb gyro weighs only $3^1/_2$ lbs.; the old one, 9 lbs. General Electric Company.

Quantity-Production Deburring Machine

Designed to provide quantity production deburring by increasing output as much as 2,100 per cent over hand labor, the Globe Burr-Rite machine features double and triple compartments that can perform two operations, polishing and deburring, simultaneously. The new, larger model finishes aluminum, brass, and die castings at a lower cost. The handling of parts has been simplified by the installation of a new hoist pan. Large lightweight doors make loading and unloading easier. To maintain continued high production, the large compartments can be relined with tough, hard maple liners without removing the shell.

The new deburring machine is available in three models. The single-compartment model has a cubic content of 18.4 ft. In the double-compartment model, each compartment has a capacity of 9 cu.ft., and in the triple-compartment model, each compartment has a 5.1-cu.ft. capacity. Despite the increased production rate, the machine occupies about the same amount of floor space as smaller models. The Globe Stamping Division, Hupp Motor Car Corporation, Cleveland.

Sealing Air-Duct Joints

The problem of sealing joints on air ducts is reported to be solved and sections of the ducts may be removed at intervals without interfering with their sealing properties. Application of the pressure-sealing zipper, a combination of rubber with metal fasteners, is credited with having made joint covering simple. With the zipper's backing material cemented around the metal duct, the zipper is pulled into place and, it is claimed, a perfect seal is obtained.

The pressure-sealing zipper goes all the way around the duct joint and can be applied to kidney shapes as well as circular cross sections. It does not occupy any more space than the non-sealing zipper. The B. F. Goodrich Company.

Check Valve Uses No Metallic Moving Parts

In the Chexflo valve operation is effected by a synthetic rubber tube, stretched over a slotted, cup-shaped metal core, which expands to open and contracts to close. Because of the fact that this expansible tube closes instantly on balanced flow, prior to the commencement of back flow, there is never any tendency to establish pressure impulses, shock, or water hammer through the flow line. The flexible tube possesses a uniform and constant spring rate which avoids inertia being set up to cause operation beyond flow requirements. It also improves in service because the "flexing" adds life to rubber. The self-compensating and wear-resistant factors of the unit are indicated as making it particularly suitable for handling even the most highly corrosive and erosive air, gases, or liquids. Grove Regulator Company, Oakland, Calif.

"Bubbles" Cleared from Engine Gear and Lubrication Systems

The problem of "breaking the bubbles" in lubricating oil used for engines has been met with what is called an antifoam agent. Distributed through the oil, this material reduces surface tension and permits each individual bubble to break quickly on reaching the surface. Thus, engine shutdowns, defects of lubricating-oil films in bearings, and the foaming-up of oil from gear boxes and bearings are said to be prevented. The antifoam agent is recommended by the maker for all types of engines, including aircraft engines. Gulf Oil Corporation.

Ideal "Air-Horse" Riveting Hammer

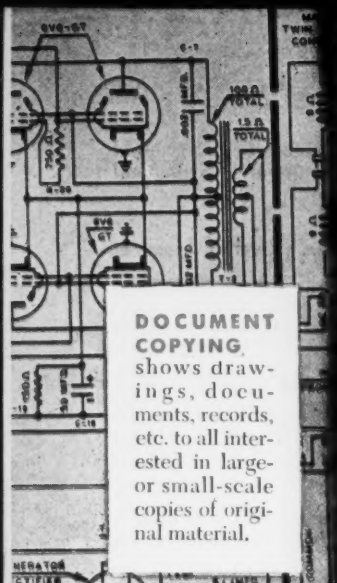
The Ideal "Air Horse" pneumatic riveting hammer is featured by small size, light weight, and controllable speed. A cooling effect is obtained because of the expansion of air which is exhausted from the front at the operating head. The barrel is of one-piece, all-steel construction, with a reinforced end to take piston impact without breaking. The piston is made of hardened alloy steel. The valve block and sleeve valve are made with large wearing surfaces for longer tool life and minimum maintenance.

An air-throttling regulator valve, included with every hammer, permits extremely fine adjustment to accommodate all kinds of riveting, even on plain or heat-treated aluminum alloy, brass, or soft iron. When used with the proper tool, the hammer is also suitable for caulking, scaling, chipping, and other work. A beehive retainer spring is easily screwed on with the fingers. The tool is available with offset or grip handle in three sizes for light, medium, or heavy riveting. Ideal Industries, Inc., Sycamore, Ill.

Photoelectric Smoke Detector for Cargo Planes

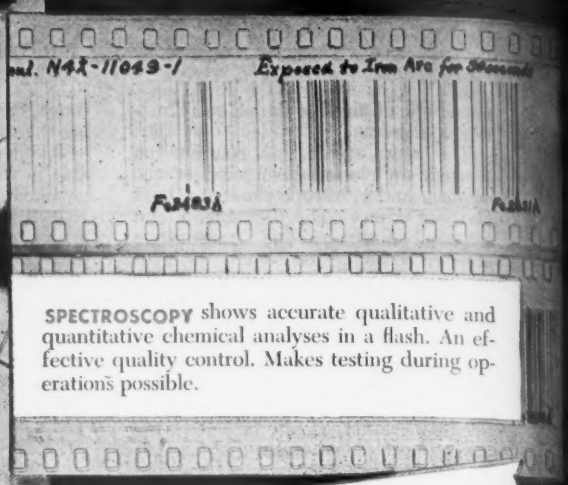
Detection of smoke by photoelectric means is being incorporated into a smoke detector for airplane cargo space. The device works on a standard 12-, 16-, 24-, or 28-volt circuit and requires an instrument that functions on slight changes in illumination on a photoelectric cell, as caused by the presence of smoke. Ordinarily, these changes in illumination are so slight as to require extreme sensitivity in the detecting instrument. The Kidde light-intercepting type of detector has a light directed on a photoelectric cell with clear air between the cell and the light source. The action of this light controls an electric circuit. The introduction of smoke into the light path reduces the light intensity reaching the cell and unbalances the electric circuit. Either audible or visible alarms are set off by this action.

In order to compensate for changes in the light source, it is necessary to use a second photoelectric cell. The second cell is located in the control housing where no interference can intercept the rays of the light. This cell is connected to the detecting cell in a balancing circuit, relative to the response relay. If the output of the light source decreases, as caused by a voltage drop, illumination decreases on both cells so that no effect is registered on the relay. However, when smoke is introduced into the light beam, the light intensity is decreased on the detecting cell only, offsetting the balance condition. Therefore the light source can be practically extinguished without affecting the response relay.



DOCUMENT COPYING shows drawings, documents, records, etc. to all interested in large- or small-scale copies of original material.

STRESS ANALYSIS shows behavior of experimental parts, speeds development, assures satisfactory performance before release for production.



SPECTROSCOPY shows accurate qualitative and quantitative chemical analyses in a flash. An effective quality control. Makes testing during operations possible.

IN A CHANGING WORLD FUNCTIONAL PHOTOGRAPHY SHOWS THE WAY...

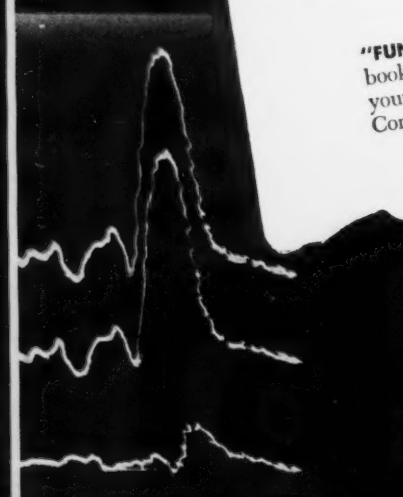
ESSENTIALLY PRACTICAL, Functional Photography more than pays its way. Reflecting the expanding needs of modern business and industry, it harnesses for those needs photography's unique powers to show . . . to record and reproduce information, much of which is beyond the ability of human vision.

In research and development, in production, in administration, Functional Photography is showing new ways to faster processes, sounder technics, lower costs, and greater efficiency in today's highly competitive world.

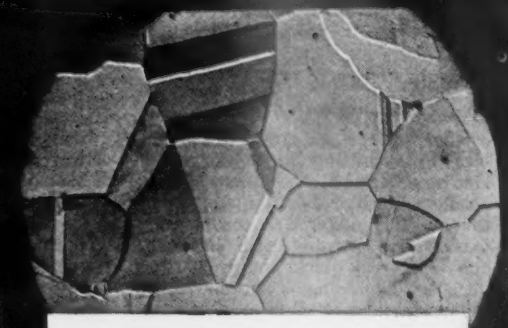
Highlighted here are a dozen examples of Functional Photography which provide a brief introduction to the wide variety of photography's uses in business and industry.

Eastman Kodak Company, Rochester 4, N. Y.

"FUNCTIONAL PHOTOGRAPHY" . . . a new, twenty-page booklet to help you determine photography's usefulness in your business. Write for your copy to Eastman Kodak Company, Rochester 4, New York.



INSTRUMENT RECORDING shows electrical or mechanical phenomena too rapid for the eye to follow. Provides a record for reference.

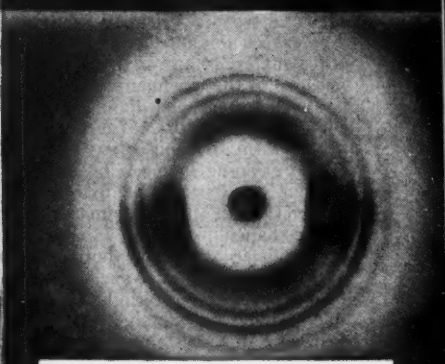


PHOTOMICROGRAPHY shows changes in grain structure caused in material by metal-working, heat-treating, etc. at magnifications up to 5,000 diameters.

PHOTO-VISUALS show workers how to perform production operations graphically, quickly.

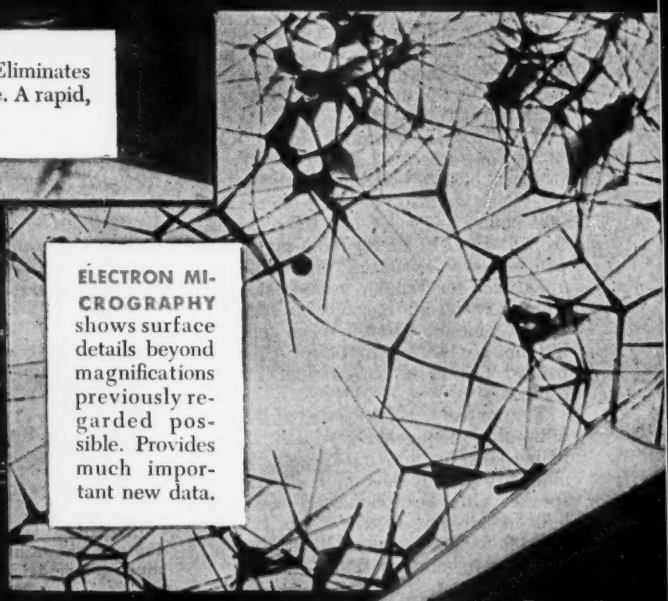
ULTRA-SPEED PHOTOGRAPHY shows action too fast for the eye to follow by stretching split seconds into minutes.

PHOTO LAYOUT puts dimensions and working instructions on metals, plastics, or other material in production. Excellent for templates and precision dials, wiring diagrams, etc.



X-RAY DIFFRACTION shows effect of processes and operations on the crystal structure of materials.

RADIOGRAPHY shows condition of internal structure. Eliminates questionable parts before they reach the production line. A rapid, dependable non-destructive production control.



ELECTRON MICROGRAPHY shows surface details beyond magnifications previously regarded possible. Provides much important new data.

RECORDAK puts hundreds of big bulky drawings or other records on a single small roll of microfilm, saves 98% in space, 99% in weight. Safeguards valuable records.

Kodak

The control housing is provided with a manual test knob that causes a test shadow bar to intercept the light path, as would be the result of smoke of the minimum density to which the detector will respond. This offers a ready and simple inspection test for the equipment. By using this intercepting-type detector, smoke of any density or color can be detected.

The equipment is of sturdy construction, and can be set to any sensitivity. The sensitivity is increased by merely lengthening the distance between the light source and the photoelectric cell. The weight increase on the airplane for a typical installation, exclusive of any external wiring and the alarms, is 3.3 lbs. When Government restrictions on materials are relaxed, the weight will be reduced to 2.3 lbs. Walter Kidde & Company, Inc., Belleville, N.J.

Disc Grinder for Metal, Wood, and Plastics

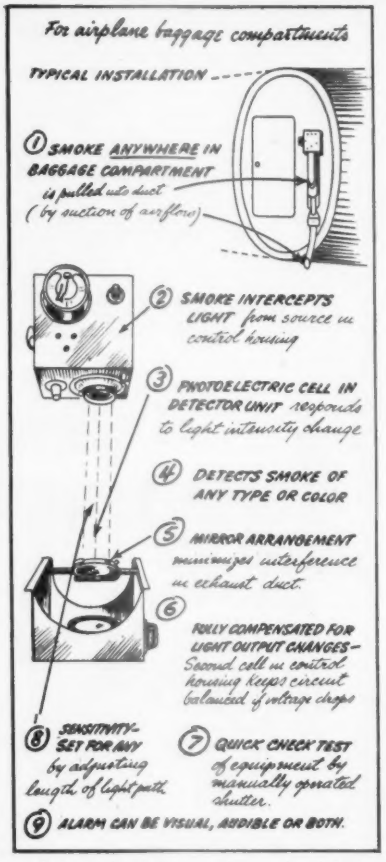
The Master 24-in. disc grinder is said to be adaptable to all kinds of grinding on metal, wood, or plastics. The specific disc speeds required for grinding these three materials are available. Special features of the machine include a heavily ribbed, normalized, and machined table; the table tilts 45° down and 25° up by worm and gear drive; both faces of the grinding disc can be used; the circular and core print fixture has a capacity of 22 in. in diameter and is wedge-shaped with 10° angle. The disc will accommodate both flexible-back cloth and paper-back abrasives. Two models of the grinder are available. Model A is supplied with its own dust-collection system; Model B is equipped with a 4-in. exhaust tube to be attached to the plant dust-collecting system. The Kindt-Collins Company, Cleveland.

Portable Radio Again Available

Production of the Learavian, the three-band portable radio receiver that was used extensively on private planes and marine craft before the war, is being resumed. The new set, though basically the same as the prewar popular model, has a number of improvements that add to its effectiveness.

The new Learavian, Model RM-402-C, operates from a.c. or d.c. power or on its own self-contained dry batteries, which have an operating life of over 200 hours. The set has three bands, from 195 to 410 kc. for radio-range and control-tower reception; from 500 to 1,500 kc. for regular broadcast, and from 2.2 to 6.2 megacycles for aircraft communication. When operating on batteries, the power cable is packed behind a hinged door in the cabinet.

The control panel is located at the top of the airplane-luggage-type case. Headphone jacks in the control panel automatically cut out the 5-in. built-in loudspeaker when headphones are used. A built-in side-tone system makes the set suitable for use for flying instruction or other intercommunication.

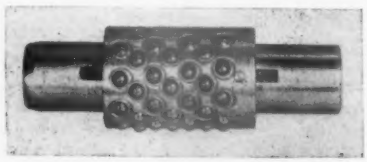

For airplane baggage compartments
TYPICAL INSTALLATION
1 SMOKE ANYWHERE IN BAGGAGE COMPARTMENT is pulled into duct (by suction of airflow)
2 SMOKE INTERCEPTS LIGHT from source in control housing
3 PHOTOELECTRIC CELL IN DETECTOR UNIT responds to light intensity change
4 DETECTS SMOKE OF ANY TYPE OR COLOR
5 MIRROR ARRANGEMENT minimizes interference in exhaust duct
6 FULLY COMPENSATED FOR LIGHT OUTPUT CHANGES – Second cell in control housing keeps circuit balanced if voltage drops
7 QUICK CHECK TEST of equipment by manually operated shutter
8 SENSITIVITY-SET FOR ANY by adjusting length of light path
9 ALARM CAN BE VISUAL, AUDIBLE OR BOTH

A typical installation of a smoke detector for cargo planes, manufactured by Walter Kidde & Company, Inc.

The receiver is 8½ in. high, 12 in. wide, and 6 in. deep. With batteries, it weighs 14 lbs. 3 oz. Lear Aircraft Radio Sales Division, Lear, Incorporated, Grand Rapids, Mich.

Antifriction Die Sets

In order to operate a punch press at the high speeds of which it is capable, it was necessary to devise a die set with guide pins that would not "freeze" because of the friction developed at these speeds. As a solution to this problem, two new types of die-set guide pins have been originated. Although originally intended for use on Lempco high-speed punch presses, it is stated that they may be used to good advantage wherever ordinary die sets are used. The round-pin style employs ball bearings, and a square-pin model utilizes roller bearings.



Lempco Products, Inc., antifriction die set. The type shown is the round-pin style. A square-pin model utilizes roller bearings.

A preload of 0.0015 in. is set up in both round- and square-pin models. After test runs of 18,000,000 strokes, 0.0005-in. preload remained. This means that the "play" between guide-post and bushing is kept to a minimum, which in turn results in considerably longer life for the die, and greater production between die grinds.

Another important economy is effected by reducing die-setters' time, since antifriction die sets open and close freely by hand. No jacks, pry bars, or similar tools are needed.

The antifriction die sets are precision made to rigid standards of accuracy. Guide-pin holes are located and bored on jig boring machines. The punch holder and die holder are matched, clamped, and bored in the same operation, so that alignment must be commercially perfect. The guide pins themselves are made of specially formulated wear-resisting alloy steel, hardened, and ground to close tolerances. All flat contact areas are precision ground to extremely fine finishes on surface grinders, then inspected and checked until they are commercially perfect. Lempco Products, Inc., Bedford, Ohio.

Automatic Operation for Metal Cutoff Saws

Saw-Matic is a newly developed attachment that converts manually operated metal cutoff saws to full automatic operation. Sold as a complete package unit ready for installation in a few hours, Saw-Matic consists of (1) pull-up device; (2) vise clamp mechanism; (3) saw lifting and lowering device; (4) supersensitive length-control valve of special design. The unit will automatically cut any length from 3/16 in. up, and will saw continuously without an attendant. Consistency in length of cut to 0.10 in. is achieved by a special friction pull-up device and an especially sensitive valve, so that the last piece sawed is the same length as the first on production runs. A special Saw-Matic unit is being built to fit each make of the more widely used metal cutoff saws.

A change from automatic to manual saw operation can be made simply by turning the hand valve on the air line. The automatic attachment will operate from as little as 60 lbs. of compressed air. Savings said to result from use of the unit are (a) labor cost is reduced since no attendant is needed during production runs; (b) tool expense is lowered by prolonging saw-blade life up to 50 per cent; (c) scrap is practically eliminated by consistently accurate cuts accomplished by the special oversize hydraulic check cylinder; (d) worker fatigue is prevented on hand operations by performing heavy saw-lifting operations with cylinder controlled by valve on the air line. Machine Specialties, Chicago.

Induction Heater for Production Soldering

A portable-bench-type induction heater is now available for use by manufacturers in various branches of in-

dustry wherever small parts or assemblies need soldering. Developed to meet the need for clean soldering of small parts and for soldering of metal to metallized glass and ceramics, the new induction heater is said to offer the possibility of radically reducing unit costs for soldering operations. It is credited with both low initial cost and economic maintenance.

The circuit design is reported to be such that the operation of the heater offers less hazard than a soldering iron, while doing neater, cleaner, and faster work. The coupling link, operating at low impedance, is provided with a grounded center tap. The unit is completely shielded for safety and to meet Federal Communications Commission requirements with reference to radio interference.

The safety features apply to components as well as to overall design. Although all components are generously rated, the circuit has been arranged to provide adequate grounding for all elements that might be damaged by arc-over. The rectifier choke and plate current milliammeter are both in the grounded center tap leg of the power transformer, placing them at ground potential. Extra-heavy, high-voltage insulation wire is used throughout, and all leads are supported.

Two switches constitute the controls. No tuning control is needed or used. One of the switches controls the power to the tube filaments, and constitutes a standby switch. In this condition, the heater consumes only 100 watts. The other switch, also mounted on the panel, is the operating switch and controls the high voltages to the tubes. Provision has been made to operate this switch circuit by foot treadle when desired.

Although the working efficiency will vary somewhat, depending upon the materials being heated, the circuit has been designed to provide maximum conversion of the 60-cycle power into heat. A specially designed low-impedance coupling link contributes to this efficiency. Efficiency is greatest when the work to be heated has a high resistivity, as in the case of ferromagnetic materials. In the case of low-resistivity materials, such as copper and silver, efficiencies are, of necessity, somewhat lower, which means that a smaller percentage of total power is converted to useful heat.

The bench-type induction heater is mounted in a standard relay rack cabinet, measures $15^3/_4$ in. by $21^1/_2$ in. by 15 in., and weighs 150 lbs. A 115-volt, 60-cycle power supply is required, but since the input is only 775 watts, special wiring is not required. Line filters are incorporated so that there is no danger of radio-frequency kickback in the line. Marion Electrical Instrument Company, Manchester, N.H.

Vibration Exciter-and-Calibrator

An electrodynamic exciter-calibrator is designed to deliver a peak force of 200 lbs. over a wide frequency range, for product testing. It enables the test operator to excite a product or part to its resonant modes of vibration with a pure sine-wave force that can be controlled in both frequency and amplitude. It provides a means for studying the nature of these modes and the most practical type of correction.

This equipment has the power to vibrate mechanical structures and parts to destruction, indicating by these failures weaknesses in the structures. It helps in locating noise sources and also duplicates age-loosening of parts which would normally require several months of operational tests.

When operating the machine above its own mechanical resonance, vibration pickups (acceleration, velocity, and displacement types) can be calibrated with a wave form as good as that of the current source. Rated accelerations as high as $20g$ are produced, with a peak of $40g$ obtainable for short periods. Maximum table travel is 1.0 in. A standard signal generator attached to the shake table will allow a check of the amplitude in comparison to the pickup being calibrated.

The table is adjustable for motion in any direction. Total weight of the vibration exciter is 685 lbs.; overall dimensions are 23 by 24 by 14 in. A motor-generator-alternator power supply is available for use with the equipment. The MB Manufacturing Company, Inc., New Haven, Conn.

Deburring Tools

With a view toward furnishing the right tool for every hard-to-get-at deburring operation, a line of hand-forged deburring tools features seven distinct types, each in varying sizes. The channel-knife type is made with sharp or square point to remove burrs from long channels and holes in machined castings. For deep holes or cross channels, there are 45° and 90° angle hooks, as well as radius-curved ends, in long or extra-long sizes. The Series "F" straight scraping tool is useful for general scraping jobs but is prescribed particularly for removing exterior burrs on machined castings. A "button hook" shaped deburrer is available in seven separate graduations. The complete line is made of fine tool steel, having unimpeded operating shafts from $4^1/_4$ in. to 9 in. in length, hollow-ground, hardened, and specially tempered.

These deburring tools are recommended by the manufacturer for nonferrous, hard metal work, or plastics. Hand-propelled, they conveniently get into places that power or flexible-shaft tools cannot reach. The tools are ready for immediate delivery, singly, unassembled, or in ready-made complete sets with nonsplitting handles. Tests are reported to have shown them especially adaptable for work on deep slots, bottom surfaces, chamfering around holes inside castings, recessed holes, top holes, and long channels. Metal Products Company, South Bend, Ind.

Light Ball Bearings

A series of light, miniature ball bearings is now available with outside diameter of $^5/_{16}$ in. and bores of $^7/_{32}$ in., $^3/_{16}$ in., $^5/_{32}$ in., and $^1/_8$ in. The bearings are manufactured of chrome bearing steel and finished to precision tolerances of $+0.0000$, -0.0002. They are credited with providing all the advantages of antifriction operation in any location where they can replace plain bearings or bushings.

Designed for use in small motors, computers, electronic equipment, drive movements of recording devices, testing and laboratory equipment, and for supporting the moving parts of various precision mechanisms, the bearings are said to accept unusually heavy loads and high speeds for their size and weight. Miniature Precision Bearings, Keene, N.H.

X-Ray Scanner

An X-ray scanner has been developed for use with Searchray 150 X-ray units. The scanner overcomes distortion and displacement that is present in most conventional methods of X-ray image recording. The unit measures 32 in. long, 14 in. wide, and 16 in. high, and consists of a motor-driven table on which the specimen and film move beneath an adjustable slit through which the X-rays pass. Table speed is $^1/_2$ to $1^1/_2$ in. per min. and can be adjusted to suit each particular application.

The scanner precisely records the geometric relationship of integrated components and spacings of segmented specimens. It is especially useful in the manufacture of any precision assembly where space measurements are desirable after parts are integrated. When fine-grain X-ray film is used, enlargements may be made for more accurate determination of element position and condition. This can serve to check component changes after certain periods of service. The scanner may also be applied to determine accurately an unknown thickness of material and to study intergranular structure of metals and plastics. North American Philips Company, Inc.

Noncorrosive Rust Remover

A rust remover has been perfected which is scientifically compounded to (1) wet metal thoroughly, (2) dissolve rust scale rapidly, (3) remove it completely, and (4) be relatively noncorrosive to steel even under conditions of long exposure. This "selectivity" is particularly pertinent to problems of removing rust from precision bearings and machined surfaces without affecting critical dimensions. Laboratory tests on highly polished roller bearings weighed to an accuracy of $^1/_{10,000}$ gram are reported to have showed weight losses of less than one-twentieth of 1 per cent even after 8 hours of immersion. Ordinary rust removal takes only a matter of seconds however, leaving no perceptible etching or discoloration of surfaces.

SAY you are operating a transoceanic airline between New York and London. And say that suddenly you are permitted to carry 400 extra gallons of gasoline on top of your maximum load. Would that be a welcome stowaway on every flight?

Welcome stowaway on every flight

We think it would. Because pilots who fly the North Atlantic know what icing conditions, headwinds and bad weather can do to a fuel supply. They know what can happen if, when fuel is low, the airport of intended landing is closed in—and an alternate landing field must be found. Could *you* use some more gas?

Those precious added 400 gallons can be carried *if* the take-off is *jet-assisted*. One AeroJet motor, weighing 205 pounds loaded, will increase the safety factor in take-off, reduce periods between engine overhauls, provide a greater fuel reserve against adverse flying conditions, and afford a wider range of choice between alternate airports in times of emergency.

Airline operators and regulatory authorities are giving the advantages of AeroJet assistance their thoughtful consideration.

Send today for your FREE copy of "Report from AeroJet"—a factual study of immediate and vital interest to everyone in aviation.
AeroJet Engineering Corporation • Azusa, Cal.

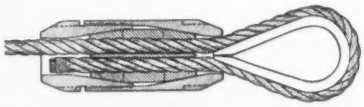
THE POWER OF TH... Aerojet

AEROJET ENGINEERING CORPORATION • AFFILIATE OF THE GENERAL TIRE & RUBBER CO.

This new rust remover can be applied by usual methods, such as brush, spray, and dip, but its durability and rapid action in otherwise inaccessible crevices make dipping the most economic wherever practical. Other uses include rust removal from castings, steel stock, fabricated parts, hand tools, etc. Nox-Rust Chemical Corporation, Chicago.

Wire-Rope Clamp

Called Cabl-Ox, a wire clamp is offered as a solution to the problem of securing wire rope. It incorporates a new wedging action in its component parts, a feature that makes it possible to hold loads in excess of the tensile strength of the rope used. The unit is alloy steel, cadmium-plated for weather protection, and streamlined for neat appearance and freedom from obstruction. It is easily assembled by unskilled labor and may be readily disassembled for the tightening of stretched lines or other purposes. It is made in all standard sizes from $^1/_{16}$ in. to $^3/_4$ in. Nunn Manufacturing Company, Evanston, Ill.



Nunn Manufacturing Company's Cabl-Ox wire rope clamp.

Sealing Compound

A general-purpose thread and gasket sealing compound, to be known as Uniseal, is credited with producing a high-efficiency seal that is proof against air, water, steam, gas, gasoline, oil, hydraulic fluids, and the aromatics. Thorough testing is reported to have shown virtual insolubility in gasoline, kerosene, Stoddard solvent, benzene, xylene, carbon disulfide, the ketones, acetones, and the various aromatic aviation fuels.

The product is a paste of uniform consistency, containing no free metallic particles that might set up corrosion attributable to galvanic action, or other additives subject to washing out. The compound flows smoothly to form ribbon gaskets and blends readily with cut gasket material.

The material is stated to possess good antiseize characteristics that aid in the assembly of threaded fittings. Solubility in alcohol and carbon tetrachloride simplifies any work of cleaning that might be necessary. Disassembly and rearrangement of work on which the new compound has been used is easier, because the seal breaks cleanly with the application of minimum force.

Exhaustive and rigorous testing shows the product to be effective under severe conditions of vibration and at temperatures above 300°F. It will be available in tubes and containers ranging from 8 oz. to 5 gal. Parker Appliance Company, Cleveland.

Waterproof Packing Material

Aquastop is described as a synthetic, impregnated, coated and chemically treated waterproof packing liner fabric. Tough and resilient, Aquastop was created to protect vital war goods during transport to foreign fighting fronts in the Arctic or tropics. With the cessation of hostilities, it is now available for peacetime jobs in improving civilian protective packaging.

With the use of this product, it is stated that an actual "breathing" package is obtained since moisture vapor as high as 10 gm. per 100 sq.in. per 24 hours is transmissible, while complete waterproofing is accomplished. This "breathing" property resists corrosion from condensation within the package caused by temperature changes.

Aquastop withstands exposure to changes in temperature from −20°F. to +175°F. at maximum relative humidity, without cracking, tackiness, flow, or loss of flexibility or waterproofness. All seams are caulked with Aquastop cement which effects a "chemical weld" of adjacent liner panels, thereby producing a completely sealed waterproof barrier between the contents and the exterior wooden shipping box. The cemented seams are as strong and as fully waterproof as the liner material. When required, it can be heat sealed at temperatures between 265°F. and 310° F. for making bags, etc.

The manufacturer states that Aquastop-protected packages will keep contents dry even after many weeks of submersion at depths where high pressures are encountered and, if the contents and box do not weigh over 60 lbs. per cu.ft. of water displacement, the sealed boxes will float for an indefinite time without damage to contents. Protective Coatings Corporation, Belleville, N.J.

Pocket Multitester

The Model 448 Pocket Multitester features six accurate testing instruments in one compact metal case. For easy reading, a 3-in. square meter is used, with a movement of 200 microamperes and a sensitivity of 5,000 ohms per volt. Ranges of the Multitester are: d.c. voltmeter 0–5–50–250–1,000 volts, first scale division, 0.1 volt; a.c. voltmeter 0–5–50–250–1,000 volts, first scale division, 0.1 volt; output voltmeter 0–5–50–250–1,000 volts, first scale division, 0.1 volt; d.c. milliammeter 0.5–10–100–1,000 milliamperes, first scale division, 0.01 milliampere; ohmmeter 0/1,000–0/10,000, 0/0.1 megacycle, 0/1 megacycle; decibel meter, −6 to +10, −14 to +26, −28 to +40, −40 to +52 db.

Decibel range is calibrated for a line of 500-ohm impedance. For lines of other impedance, correction charts are supplied. The size of the Model 448 is $5^7/_8$ in. by $3^1/_{16}$ in. by $2^1/_8$ in. It weighs only $1^3/_4$ lbs., complete with self-contained batteries, ready to operate in snap-spring contact holders. Radio City Products Company, New York.

New Size Collet Air Chuck

A new size collet air chuck, to be known as the No. 10, will be the same size as the present No. 00 but will use the No. 10 collets, the same as used on Brown & Sharpe High Speed Automatics. By the use of an adapter sleeve and nose cap the No. 10 Chuck will employ the regular No. 00 collets. This will make available a small, compact collet air chuck with increased capacity, since the No. 10 collets have a size range from $^1/_{16}$ in. to $^1/_2$ in. Redmer Air Devices Corporation, Chicago.

Water-Thin Flux at 800° F.

Available for use in civilian production, NU-Braze Wonderflux #4 is cited as an advance in silver-brazing fluxes. It melts and forms a protective coating over the metal surfaces at 480°F., well below the oxidation temperature of most metals. Thus, the flux eliminates oxides by actually preventing their formation. At 800°F., the point where ordinary brazing fluxes first begin to melt, this product is water-thin, and will readily flow through clearances as close as 0.001 in. It is stated to be especially effective on stainless steels.

NU-Braze Wonderflux #4 has a hydrogen concentration of 5 to 6, which means that for all practical purposes it can be considered neutral. It can be painted on parts and allowed to remain for long periods without producing corrosion. Should some of this flux remain trapped in an inaccessible part of the joint, it would not pick up water at a later date and thus cause corrosion, because it is non-hygroscopic.

Because it is water-thin at its operating temperature, the flux is gently and completely eased out of the joint by the molten brazing alloy, thereby eliminating the possibility of flux inclusions in brazed joints. After it is melted, the flux hardens to an extremely brittle glass which can usually be jarred from the brazed part. It is easily removed by either hot or cold water.

After the water content leaves the flux at 212°F., there is no further effervescence. This quality is said to make the flux especially useful where brazing alloys are used in the form of powder, since it will not spatter the alloy powder away from the joint area. The flux contains no free fluorides and does not release objectionable volumes of noxious fumes. Sherman & Company, New York.

Light-Duty Push-Pull Control Systems

The unique feature of the Simmonds Light-Duty Push-Pull Type 4L controls is the patented linkage, by which phosphor bronze bearings swaged on flexible cable give unusual strength in both compression (push) and tension (pull) loads. A wide variety of fittings and accessories makes the unit adaptable to a considerable range of installations.

Production methods developed during the war have made possible low prices for this device, so that in many

instances it is proving less expensive than inferior equipment. Simmonds Aerocessories, Inc., New York.

Mechanical Finishing Machine

The Roto-Finish mechanical process of finishing and deburring parts may now be performed with greater efficiency with a new 60-in. wet-process machine. The machine may be had with one to five compartments, permitting processing of that many different sizes of parts simultaneously. A cam lock enables the operator to remove the door easily and quickly, and to load and unload with minimum time to shorten the cycle of operation. This door lock has a spring feature that permits any gases to escape that might build up in the cylinder. Lining of the octagonal cylinder is easily removable, permitting speedy relining of the cylinder with fitted hardwood.

The machine is used in the Roto-Finish wet process employing predetermined combinations of chips and compounds to finish and deburr at the same time. It is suited particularly to production finishing of parts, increasing the savings in time and labor gained by the mechanical finishing method. The process used in the 60-in. machine cuts the time cycle from 25 to 50 per cent, depending on the type of part processed. With parts having a brighter, more uniform finish, plating costs are in turn reduced. Sturgis Products Company, Sturgis, Mich.

New Heating Package for DC-3

A Janitrol aircraft-heater package is expected to effect economies in the operation of the Douglas DC-3 aircraft and provide new standards of comfort. The heater package adds approximately 50 lbs. pay load to the DC-3, being 50 lbs. lighter than the previous system used on most DC-3's. Additional operating economies are obtained by the fact that the heating package, which is contained in a 12-in. by 15-in. by 49-in. fabricated aluminum-alloy jacket and is to be located in the baggage compartment, can be replaced for servicing and inspection in 15 min.

The heating package contains one Janitrol whirling-flame aircraft heater with a maximum output of 125,000 B.t.u. when installed in a DC-3; also fuel pump, high-voltage spark ignition system, ventilating and combustion air blowers, sensitive thermostatic temperature controls, and other component parts. The ease and speed possible in modifying DC-3's with the Janitrol heating plant is attributed to the fact that the new heating package was designed to utilize the present DC-3 heat-distribution system.

Improvement in passenger comfort is provided by the new heating package. Despite its lighter weight, the heater is reported to deliver more heat and ventilating air than the previous system. Cabin temperatures can be maintained within 2° of the thermostat setting and the system can be operated by the stewardess or other nontechnical personnel. The packaged blowers make possible both heat and ventilation when the plane is on the ground and engines are not running.

The DC-3 heater package is a refinement of the Janitrol whirling-flame heater developed during the war and installed on all types of military and commercial planes. Surface Combustion Corporation, Toledo, Ohio.

Cold-Starting Fuels for Aircraft Eliminate Engine Preheating Equipment

A newly developed cold-starting fuel for aircraft operating in sub-zero temperatures reportedly reduces the time required for preparation and starting from as long as 6 hours to 2 min. This fuel is designed to replace high-octane gasolines for only the brief interval required to start the engine.

Made up from the necessary low-boiling-point fractions, the fuel is used in regular aviation carburetor and priming systems. A portable external tank or bottle is attached to regular fuel lines, shutting off main fuel lines, and allowing the special fuel to flow for about 2 min. After the engine is warmed up, the portable external tank may be disconnected by the ground crew, and the engine then draws its fuel from regular gasoline tanks. The cold-starting fuel is liquid at all atmospheric temperatures and can be shipped in regular containers, making special high-pressure containers unnecessary, in contrast to propane-butane fuels which would boil off at temperatures of 34°F. or lower, and which therefore require the heavy pressure containers.

Although development of these cold-starting fuels has great value for military operations, it will also prove a valuable peacetime aid for all transpolar and "bush" flying, and feeder lines operating in all extremely cold climates. The Texas Company.

Electronic Test Equipment

Release of the "B" Sweep Calibrator Model No. 8127 has been effected for commercial use in radar and television test work. This instrument provides calibration marks for use in calibrating the sweep speed of a synchroscope or triggered sweep oscilloscope. The markers consist of short video pulses, of less than $\frac{1}{2}$ microsecond duration, spaced apart by a known number of microseconds.

Switch permits choice of four different time intervals between calibration markers: 2.5, 10, 50, and 100 microseconds. Markers have an amplitude of 40 volts, with choice of polarity. The positive trigger has an amplitude of 120 volts; negative 65 volts. The repetition rate is continuously variable by means of a calibrated control from 2,000 to 3,000 cycles per sec. Operation is from an external trigger pulse, positive or negative, of 66 volts. A continuously variable gate length has a duration of 20 to 3,000 microseconds. (Gate length is the length of time during which markers are generated following each trigger pulse. All markers that would appear subsequent to this interval are suppressed.) Operating voltage is 110 to 120 volts, 60 cycles. Power consumption is 85 watts. The weight is 23 lbs.; height 8 in.; length 16 in.; depth $7\frac{7}{8}$ in.

This unit was designed in collaboration with the Radiation Laboratory of the Massachusetts Institute of Technology. United Cinephone Corporation, Torrington, Conn.

Contact Light for Airport Runways

A new contact light is announced for airport runways. The light, only 1 ft. in diameter and projecting above ground only $2\frac{3}{4}$ in., is interchangeable with Army-Navy standard contact light-mounting dimensions. The unit is reported to give better light output, to meet all Army-Navy-C.A.A. requirements, and will carry a dead load of over 50 tons. This is equivalent to the load imposed by a 200,000-lb. airplane taxiing during take-off or landing.

The frame is cantilever type, made from one of the new high-strength alloy steels developed during the war. The frame carries the load and the lens floats on synthetic-rubber gaskets. The lens has high light-transmission values, and is heat-treated to withstand heavy impacts, but in case of breakage it flies into thousands of small pieces, having no sharp edges to cut tires. Westinghouse Electric Corporation.

Wartime Research and Engineering Developments Utilized for Peacetime Purposes

In a report of the research and engineering activities of Westinghouse Electric Corporation during 1945, contributions of the company to scientific advances are reviewed. The report deals not only with wartime developments of 1945, but also with innovations of previous wartime years which were first revealed to the public in the past year. At the same time, it notes particularly the conversion of war implements to peacetime uses.

As outstandingly important for peacetime applications, it summarizes the progress and indicates the significance of the adaptation of the geared gas turbine to aircraft propulsion; radar for use in navigation and adaptation to Stratovision; application of tank-gun stabilizers to create smoother rides for railroad passengers; and adaptation of numerous war-developed materials and alloys for making better industrial products. Other developments outlined include those connected with the creation of the atomic bomb, various electronic devices, the "aisle of light" method of illuminating runways, and silicones. Westinghouse Electric Corporation.

Electric Starters for Gas Turbines

To start such jet propulsion turbines as the 19B, a 10-hp. lightweight electric starter has been developed. The function of this starter is to bring the compressor and turbine rotor from standstill to at least 2,000 r.p.m. in about 15 sec. The starter is rated at 10 hp., 17 volts at 6,000 r.p.m. (it uses a 4 to 1

gear) but develops 18 hp. at peak output. The rating is on a 30-sec. basis. The weight is light, only 31 lbs. A multiple-plate friction clutch is interposed between the motor and the jaw engagement to enable rapid starting with safety.

The starter gets its power from the plane's 24-volt batteries. To obtain maximum power with least drain on the battery, the motor was designed with impedance to match that of the battery and circuit. Since the inrush current is approximately 1,800 amp., a serious commutation problem had to be overcome and was solved by the use of a special grade of halide-treated brush.

This starter is but one of three types now in production and is the forerunner of several types and sizes that will be required for gas-turbine starting. Work has already begun on a starter about half as large, for accessory gas-turbine power plants. Westinghouse Electric Corporation.

Lightweight Air-Cooled Engine

The Wright Cyclone 9HD is stated to be the lightest air-cooled engine per horsepower. It develops 1,425 hp., 75 more than its immediate predecessor in the Cyclone 9 series, yet weighs only 1,352 lbs., and delivers one horsepower for each 0.85 lb. of dry weight.

It is reported that the 9HD is installed in the Curtiss SC-2 Seahawk and in other experimental military aircraft. Certain domestic and foreign air lines have purchased models for long- and short-haul transports. The engine's low weight and high output are credited with permitting either increased pay loads or extended range for commercial planes.

Basically, the 9HD is built on the same lines as earlier models of the Cyclone 9 type, but advancement in cooling, supercharger efficiency, and structure have enabled engineers to develop increased output from the 1,823 cu.in. which have been standard displacement of the series for several years.

Cooling in the Cyclone 9 has been improved by use of a new-type forged-aluminum cylinder head with differential finning. Among structural features are the added strength gained through use of the forged head, stronger power-transmission parts, oil jets for increased cylinder and piston-ring lubrication, high-durability valves, and increased cam overlap for improved detonation characteristics.

An "impeller inducer" which adds to both pressure and efficiency of the supercharger is used in the Cyclone 9HD to permit it to maintain power at higher altitudes than were attainable with former engines of the series.

The manufacturer plans to produce the engine in four models which will have either single or two-speed supercharging and two alternate reduction-gear ratios. All four models produce one horsepower for less than 1 lb. of weight.

Specifications for the 75OC9HD, lightest of the group, are as follows: take-off horsepower, 1,425 at 2,700 r.p.m. to 3,000 ft.; rated power, 1,275 at 2,500 r.p.m. to 4,300 ft.; recommended maximum cruise power, 895 at 2,250 r.p.m. to 10,500 ft.; dry weight, 1,352 lbs.; fuel, 100/130; bore, $6^1/_8$ in.; stroke, $6^7/_8$ in.; fuel consumption at cruising horsepower, 420 lbs. per hp.-hour; displacement, 1,823 cu.in.; oil consumption at cruising horsepower, 0.02; compression ratio, 7.21 to 1; reduction-gear ratio, 1 to 0.4375; diameter, 56.77 in.; length 47.69; magneto, Edison-Splitdorf; carburetor, Stromberg. Wright Aeronautical Corporation.

I.A.S. Honors Night Victory Dinner

(*Continued from page 37*)

the Institute that has shown itself for many years. Your Institute will be in good hands.

I present to you your new President, Mr. Arthur E. Raymond.

Acceptance by Mr. Raymond

Mr. Arthur E. Raymond: The Constitution of the Institute states that the new President shall take office upon the conclusion of the Annual Meeting, which this year takes place two days hence. Consequently, my position here tonight is at best unconstitutional.

I do, indeed, feel greatly honored to have been selected as President of the Institute for 1946. There have never been as many scientists, engineers, and technicians engaged in the field of aeronautics as there are today, and the demand for them continues to exceed the supply. Not only is this so, but the field itself continues to expand until there remain very few sciences not associated with it in some way.

This calls for an enlargement not only in the membership of the Institute, but in the scope of its activities. Its historical records, its libraries, its publications, its meetings, its buildings, its foundations, and its awards can provide a stimulus to increased effort and achievement that is definitely needed if this country is to remain strong. All of us must see to it that the Institute of the Aeronautical Sciences meets this challenge and this opportunity.

My duty tonight is to bring these proceedings to a close. I shall now do so with celerity and dispatch. Thank you for coming to help us honor those who have received their awards.

I.A.S. Fourteenth Annual Meeting

(*Continued from page 49*)

Publications and Publishers

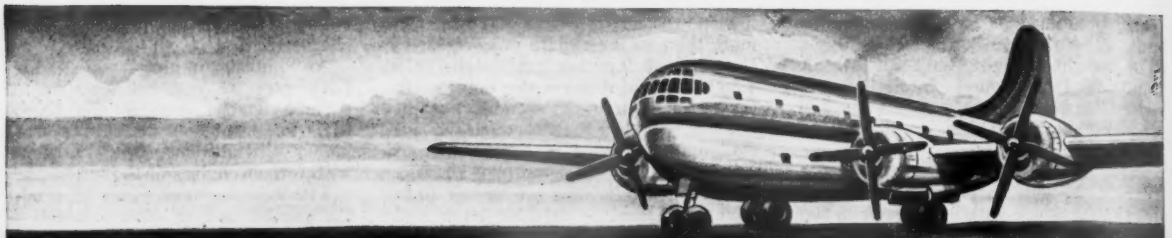
Aero Digest
Air-Age Education Research
Air Age, Inc.
Air Facts
Air Force
Air News
Air Trails
Airways
Aviation
Crowell-Collier Publishing Company
Thomas Y. Crowell Company
Doubleday, Doran & Company, Inc.
Encyclopaedia Britannica, Inc.
Farrar & Rinehart
Flying
Fortune Magazine
London Daily Mail
Life Magazine
The Nation
New York Sun
Printers' Ink
Southern Flight
Unicorn Press Publishers

Schools and Universities

Academy of Aeronautics
Polytechnic Institute of Brooklyn
Columbia University
Cornell University Medical College
New York University
Pennsylvania State College
University of Pennsylvania
Princeton University
Tottenville, S.I., High School
Wayne University
Webb Institute of Naval Architecture

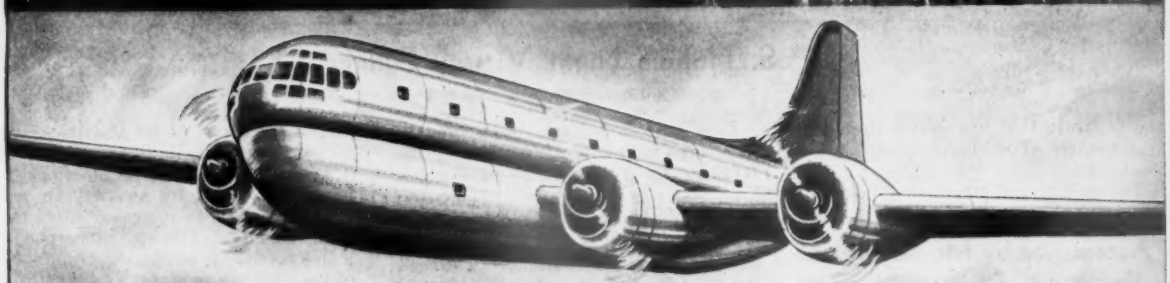
Government Agencies

British Information Services
Chinese Air Force
French Air Ministry
Metropolitan Museum of Art
Royal Netherlands Naval Air Force
Newfoundland Government Information Bureau
Port of New York Authority
Provisional International Civil Aviation Organization
Swedish Legation
U.S. Army Air Forces
U.S. Army Signal Corps
U.S. National Advisory Committee for Aeronautics
U.S. National Bureau of Standards
U.S. National Research Council
U.S. Navy
U.S. Office of Scientific Research and Development
U.S. Office of Strategic Services

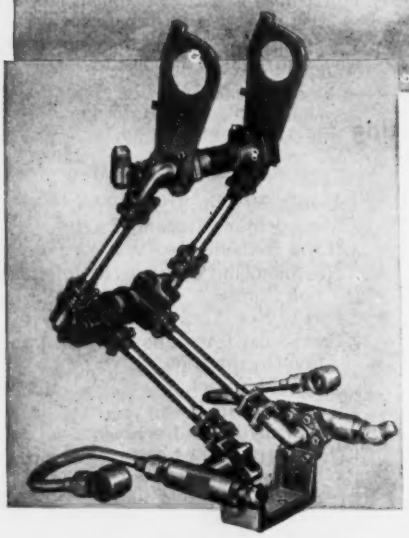


BIG SHIP

BIG RESPONSIBILITY



BOEING PICKS BARCO



Selection of Barco Flexible Joints and other Barco Products for the huge Boeing Stratocruiser is a high tribute to Barco engineering standards. Fluid-conveying lines require unfailing protection against vibration strain and shock, particularly in such giant planes, flying at extreme altitudes and great speeds. Acceptance of Barco dependability for our most advanced combat aircraft during the war has led to a similar choice for postwar passenger and cargo ships. A competent engineering staff is ready to aid you in such problems.

Further information on request.

Ask about our 3,000-pound pressure Swivel Joint for aircraft cylinders and other installations.

BARCO FLEXIBLE JOINTS

Manufacturing Company, Not Inc., Aircraft Products Division, 1826 Winnemac Avenue, Chicago 40, Illinois

Not just a swivel joint . . . but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

Free Enterprise — The Cornerstone of American Prosperity.

"MOVE IN EVERY DIRECTION"